U.S. Army Center for Health Promotion and Preventive Medicine

USACHPPM REPORT NO. 12-HF-0APLa-08
U.S. ARMY ANNUAL
INJURY EPIDEMIOLOGY REPORT 2007

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14. ABSTRACT
Injuries are a leading cause of death, disability, and medical encounters among active duty U.S. Army personnel. Medical surveillance data provide a useful tool for defining the magnitude of the Army injury problem, injury rates and trends, and causes of injuries. This report summarizes injuries among non-deployed, active duty U.S. Army Soldiers in 2007 using available medical surveillance data. In 2007, over 890,000 medical encounters were due to injury. Among all Army Soldiers, the 2007 injury visit rate was 2,233 injury visits/1,000 Soldiers, or 2.2 visits/Soldier. Injury visit rates increased slightly in recent years (22.8% from 2005 to 2007), while trainee rates from 2003 to 2007 declined by 27.2%. Injuries accounted for 19.9% of all hospitalizations and 28.5% of outpatient visits. Leading causes of unintentional injury hospitalizations were falls/near falls (16.9%), land transport accidents (16.8%), and athletics/sports (11.9%). Leading types of acute injuries were sprains/strains, contusions/superficial wounds, and fractures. Leading chronic injury conditions were inflammation and pain (overuse) and joint derangements. These results provide important indicators of potential injury prevention targets and research priorities. Summaries of Injury Prevention Program (IPP) analyses, field investigations, and evaluations completed in 2007 are also presented. Topics included the examination of predictors of injuries and attrition in basic training, seasonal variations in injury rates during Ordnance School training, and the effectiveness of parachute ankle braces on reducing ankle injuries during military airborne operations.

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EXECUTIVE SUMMARY
INJURY PREVENTION REPORT NO. 12-HF-0APLa-08
U.S. ARMY ANNUAL INJURY EPIDEMIOLOGY REPORT 2007

1. PURPOSE. The main purposes of this report are as follows:

a. To present and summarize available non-deployment medical surveillance data for use in injury prevention program and policy planning, including—

(1) Defining the relative impact of injury compared to other medical conditions among U.S. Army Active Duty personnel in 2007.

(2) Providing baseline Army injury rates and trends from 2000–2007.

(3) Identifying leading causes of injury hospitalizations and injury types for 2007.

b. To provide a summary of key results from non-deployment-related analyses, field investigations, and evaluations completed in 2007 by the Injury Prevention Program at U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM).

2. CONCLUSIONS.

a. Army Injury Surveillance Summary 2007. This section summarizes available medical surveillance data on injuries affecting Active Duty, non-deployed U.S. Army Soldiers. Key findings indicated—

(1) For every 1 injury-related death, there were 20 hospitalizations and 1,512 outpatient visits in 2007.

(2) Injury was the leading cause of medical encounters (899,381 medical encounters in 2007), affecting over 390,000 Soldiers.

(3) Among Army Soldiers, injury visit rates, particularly overuse injury rates, have been increasing in recent years (22.8 percent from 2005 to 2007), while rates among Army trainees from 2003 to 2007 declined by 27.2 percent.

(4) Injury was one of the leading causes of hospitalization among Army Soldiers (6,846 hospitalizations in 2007), exceeded only by mental disorder. However, injury and injury-related

musculoskeletal conditions resulted in more outpatient visits (514,083 outpatient visits) than any other medical condition.

(5) The most frequently reported causes of unintentional injuries that required hospitalization were falls or near-falls (16.9 percent), land transport accidents (16.8 percent), and athletics/sports (11.9 percent).

(6) The most common types of injury leading to hospital admission were fractures (35.9 percent), internal injuries (12.2 percent), and sprains/strains (10.2 percent). Injury hospitalizations were more likely to involve the lower extremities or the head, face, and neck regions.

(7) Injury-related outpatient visits were most commonly the result of sprains and/or strains (48.9 percent), contusions/superficial wounds (17.0 percent), and fractures (9.3 percent), particularly sprains and strains to the lower leg, ankle, shoulder, and upper arm.

(8) The most common types of injury-related musculoskeletal conditions leading to hospital admission were joint derangement (49.5 percent), inflammation and pain associated with overuse (23.3 percent), and sprains/strains/ruptures (15.4 percent). Injury-related musculoskeletal conditions resulting in hospitalizations were more likely to involve the spine/back or extremities.

(9) Most injury-related outpatient visits were due to inflammation and pain associated with overuse (85.6 percent), followed by joint derangement (7.4 percent), and joint derangement with neurological involvement (2.9 percent), primarily affecting the spine/back and the extremities.

b. Army Injury Epidemiology Project Summaries 2007: Analyses, Investigations, and Evaluations. Conclusions from USACHPPM Injury Prevention Program non-deployment related injury investigations completed in 2007 were as follows:

(1) USACHPPM. 2007. *The Recruit Assessment Program and Predictors of Injury in U.S. Army Basic Combat Training.* (Prepared by: Hauret, KG, Canada S, Canham-Chervak, M. and Jones BH. Presented at the Annual Force Health Protection Conference, August 2007). Twenty six percent of male and 52 percent of female recruits in the study population were injured during Basic Combat Training (BCT) at Fort Jackson in fiscal year (FY) 2003. Univariate analysis indicated that the number of cigarette packs smoked daily was associated with BCT injury for both male and female recruits. In multivariate modeling, the number of cigarette packs smoked daily was an independent risk factor for injury among females only. Age at onset of smoking was a stronger independent risk factor for injury among male recruits than the number of packs smoked. Less participation in sport/activity prior to BCT was associated with a higher probability of injury among female recruits. Additional BCT injury risk factors

were identified, including: older age, higher body mass index (BMI), and lower education for both male and female recruits; white race; history being assaulted; emotional health impact; early onset of smoking; stiff/painful joints for males recruits; multiple family relocations as a child; fewer close friends/relatives; treated for on-the-job injury; missed work due to injury; less physically active; and higher number of cigarette packs smoked daily for female recruits.

(2) USACHPPM. 2007. *The Recruitment Assessment Program and Predictors of Attrition in U.S. Army Basic Combat Training.* (Prepared by: Canada S, Canham-Chervak, M, Schmitt C, Strauss W, Buck D, and Hauret K. Presented at the Force Health Protection Conference,). Attrition for study population (9 percent) was similar to attrition for all recruits at Fort Jackson (10 percent) in FY03. Thirteen percent of female recruits in the study population attrited during BCT compared to 6 percent of male recruits. Consistent with prior studies, the following risk factors were significant predictors of BCT attrition in the multivariate analysis: regular cigarette smoking and lower Army Forces Qualification Test for both male and female recruits, previous injury for male recruits, and history of sexual abuse for female recruits. This analysis also indicated that self-reported –poor" general health, work and daily activity limitations due to physical health, history of shortness of breath, as well as citing travel and adventure as reasons for joining the military were associated with higher attrition for both male and female recruits. Days in the Physical Training and Rehabilitation Program and number of allergies were also identified as significant predictors of female attrition during BCT. In addition, male recruits with a history of knee trouble were associated with higher BCT attrition.

(3) USACHPPM. 2007. *Trends of Injury Topics in a Major Military Safety Publication, 1999-2005*. (Prepared by: Canada S, Canham-Chervak, M. and Jones BH. Unpublished). Two of the top five causes of injury hospitalizations, private vehicle accidents, and machinery/tools are among the top five injury topics covered in the U.S. Army safety publications, *Countermeasure*, from 1999 to 2005. However, two of the other top five causes of injury hospitalizations—falls and athletics/sports—ranked 9th and 13th of the *Countermeasure* articles appearing from 1999 to 2005.

(4) USACHPPM. 2007. *Seasonal Variations in Injury Rates in United States Army Ordnance Training*. (Prepared by: Knapik, JJ, Jones S, and Jones BH. Presented at the Annual Force Health Protection Conference). The findings support previous work conducted in BCT, which demonstrated seasonal variations in injury rates– the highest during summer months– potentially due to higher environmental temperatures.

(5) USACHPPM. 2007. Technical Report No. 12-MA01Q2-07, *The Parachute Ankle Brace: Entanglements and Injuries After Controlling for Extrinsic Risk Factors.* (Prepared by Knapik JJ, Darakjy S, Swedler D, Manning F, Hauret KG, Amoroso P, and Jones BH). Consistent with previous studies, the parachute ankle brace (PAB) reduced ankle injuries during military airborne operations. This investigation expanded on previous work by showing that this protective effect was retained even when other known extrinsic parachute injury factors were

taken into account. After controlling for covariates known to affect injury rates, the PAB protected against ankle injuries and especially ankle sprains, while not increasing parachute entanglements or causing other lower body injuries exclusive of the ankle.

(6) USACHPPM. 2007. *Army Motorcycle Crashes: A Descriptive Analysis of Accidents from CY 99-06*. (Prepared by: Marin RE, Canada S, and Jones BH. Presented at the Annual Force Health Protection Conference). Motorcycle accidents and fatalities among Army Soldiers have been on the rise. Alcohol use, not wearing a helmet, and nighttime driving are risk factors for being fatally injured in a motorcycle crash.

3. RECOMMENDATIONS.

a. Army Injury Surveillance Recommendations 2007.

(1) Given the magnitude of the injury problem in the Army as demonstrated by these data, resources should be directed toward injury prevention and research activities.

(2) To systematically address Army injuries, a data-driven prioritization process is recommended to focus resources on the leading Army injury problems.

(a) The process should include the analysis of non-fatal medical surveillance data, as presented in this report, given that the bulk of the Army injury burden is non-fatal injuries.

(b) When formulating prevention priorities, factors that should be considered include the frequency, incidence, and severity of injuries; resulting costs; size of the population at risk; preventability of the problem; feasibility of establishing prevention programs or policies; and the ability to evaluate the effect of implemented programs and policies.

(c) When formulating research priorities, factors that should be considered include the frequency, incidence, and severity of injuries; resulting costs; size of the population at risk; existence of gaps in knowledge; military uniqueness; potential value of the research; and feasibility of the research.

(3) Results of this analysis should be used to inform injury prevention and research priorities.

(a) Falls/near-falls, transport accidents, and sport-related injuries were identified as the leading causes of serious (hospitalized) injuries in 2007.

(b) Fractures, sprains and strains, and overuse injuries of the back and lower extremities were identified as the leading injury types in 2007.

(4) Data in this report should also be combined with future injury surveillance analyses to identify trends in injury rates and causes over time.

b. Recommendations from Army Injury Epidemiology Projects 2007.

(1) USACHPPM, *Predictors of Injury in U.S. Army Basic Training and in the First 2 Years of Military Service.* Analyses exploring the associations of self-reported health status and health risk behaviors should be conducted for additional time periods (first 6 months of service and pre- and post-deployment periods) using the Recruit Assessment Program data set. Results should be used to inform injury prevention program development.

(2) USACHPPM, *Predictors of Attrition in U.S. Army Basic Combat Training and in the First 2 Years of Military Service.* Similar attrition risk factor analyses for post-basic combat training, including first 6 months of service, time after first deployment, and first- term enlistment should be explored using the Recruit Assessment Program data set. Develop targeted screening and prevention programs aimed at reducing attrition, considering significant risk factors identified in this analysis.

(3) USACHPPM, *Trends of Injury Topics in a Major Military Safety Publication, 1999-2005.* To enhance contributions toward injury prevention, publications that serve as a key means of disseminating safety information should attempt to focus their content on leading causes of injury as defined by medical surveillance data.

(4) USACHPPM, *Seasonal Variations in Injury Rates in United States Army Ordnance Training.* Leaders should be aware that injuries will be higher in the summer and should follow the work/rest recommendations and water replacement guidelines in Field Manual 21-10*, Field Hygiene and Sanitation,* 21 June 2000.

(5) USACHPPM, *The Parachute Ankle Brace: Entanglements and Injuries after Controlling for Extrinsic Risk Factors.* The PAB should be used during military parachute training to reduce injuries. Further studies in operational units should be conducted with experienced parachutists to see if the PAB can increase operational combat capability through injury reduction.

(6) USACHPPM, *Army Motorcycle Crashes: A Descriptive Analysis of Accidents from CY 99-06.* Systematic surveillance and reporting on motor vehicle accident causes and rates are necessary to identify modifiable factors to mitigate motor accident fatality rates. Data suggest priority should be placed on promoting helmet use, decreasing alcohol use, and reduction of nighttime driving.

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1. REFERENCES. References are listed in Appendix A.

2. PURPOSE. The main purposes of this report are as follows:

a. To present and summarize available medical surveillance data for use in injury prevention program and policy planning, including—

(1) Defining the relative impact of injury compared to other medical conditions among U.S. Army Active Duty personnel in 2007.

(2) Providing baseline Army injury rates and trends from 2000-2007.

(3) Identifying leading injury diagnoses and causes of injury hospitalizations for 2007.

c. To provide a summary of key results from non-deployment-related analyses, field investigations, and evaluations completed in 2007 by the Injury Prevention Program at U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM).

3. AUTHORITY. Under U.S. Army Regulation (AR) 40-5, Section 2-19, the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) is responsible for providing support of Army preventive medicine activities, to include review and interpretation of surveillance data and identification and characterization of health problems as a foundation for injury prevention planning efforts.

4. BACKGROUND.

a. Injuries have historically been a leading cause of death, disability, and medical encounters in the U.S. Army. From 1980 to 1993, unintentional injuries were the leading cause of death, with rates typically more than twice the rates of death due to illness or intentional injuries.[1] In 1994, musculoskeletal conditions and injuries accounted for over half (53 percent) of all Active Duty Army disabilities.[2] From 1981 to 1994, rates of musculoskeletal conditions and acute injuries were consistently among the top three contributors to overall hospitalization rates.[3] More recent data suggest that, from 2000 to 2006, injury-related musculoskeletal conditions and acute injuries have remained a leading cause of hospitalization and outpatient visits among Active Duty Army personnel. During this time period, between 22 percent to 26 percent of hospitalizations and 24 percent to 33 percent of outpatient visits were for acute injuries and injury-related musculoskeletal conditions each year.[4, 5]

b. The first step in the public health approach to prevention is to define the problem.[6, 7] Analysis of Active Duty Army data from the Defense Medical Surveillance System (DMSS), which captures all inpatient and outpatient medical encounters for active duty U.S. military personnel,[8] provides an opportunity to describe medical encounters for injuries in relation to other health problems, evaluate injury rates over time and in selected populations, and identify leading injury types and causes. A summary of 2007 Army DMSS data is presented in the first section of this report. Such information can be used by health policymakers, public health practitioners, and others to make data-driven decisions regarding prevention resources and efforts.

c. Other steps in the public health process include identifying causes and risk factors, developing and testing interventions, and evaluating implemented programs and policies.[6, 7] The second section of this report provides a summary of selected non-deployment injury analyses and a list of peer-reviewed publications produced by the USACHPPM Injury Prevention Program (IPP) in 2007. The intent of this section is to provide a summary of IPP epidemiologic analyses, field investigations, and evaluations, all of which focus on advancing knowledge of risk factors and/or interventions addressing key military injury issues.

5. METHODS.

a. Army Injury Surveillance Summary 2007: Death, Hospitalizations, and Outpatient Visits. The first section of this report uses existing medical surveillance data from DMSS[8] to describe the nature of the injury problem in the U.S. Army. Data include all non-deployed U.S. Army Soldiers in the Active Component (hereafter referred to as ‗Active Duty') for the 2007 calendar year. The DMSS data on fatalities, hospitalizations, and outpatient visits were requested from the Armed Forces Health Surveillance Center (AFHSC) in July 2008.

(1) Fatality data contained in the DMSS originate from two data sources: Washington Headquarters Service and Armed Forces Institute of Pathology. Data received regarding the manner of death fell into one of eight categories: neoplasm, cardiovascular, suicide, homicide, transportation, other accidents, war/legal intervention, and all others. Transportation, other accidents, homicide, and suicide casualties were counted as injury-related deaths in this report.

(2) Hospitalization (inpatient) and outpatient visit data are obtained from DMSS, which draws data from Executive Information Decision Support. Data include treatment received within the military health system, as well as treatment outside the military health system that was paid for by the U.S. military. All data on medical conditions other than injuries are reported according to the 17 major diagnosis code groups as outlined in the International Classification of Disease, Ninth Revision, Clinical Modification (ICD-9-CM)[9].

(3) Injuries resulting in hospitalization and outpatient treatment were identified by ICD-9-CM diagnosis codes from the 800-999 code series for acute (traumatic) injuries and 716-739 code series for injury-related (chronic) musculoskeletal conditions, in concordance with recommendations for monitoring of military injuries and existing military injury data reports produced by AFHSC.[10] See Appendix B for a complete list of specific ICD-9-CM codes used. A "60-day" unique hospitalization/outpatient rule was established for this analysis, unless otherwise specified, in order to reduce the effect of follow-up injury visits and potential overestimation of frequencies and rates. The rule states that multiple visits for the same 3-digit ICD-9-CM diagnosis within 60 days of the initial visit will be counted only once.

(4) The relative burden of injuries and diseases is characterized in this report by three indicators: (1) the total number of medical encounters for each major diagnosis group, (2) the number of individuals with one or more of a particular diagnosis for each major diagnosis group (visits for duplicate diagnoses excluded), and (3) the number of hospital bed days attributed to each major diagnosis group.

(5) Rates are reported for all non-deployed Active Duty Soldiers and all Soldiers-in-training (trainees) for the years 2000-2007. Rates are calculated for *all* injury visits (i.e. follow-up visits included; 60-day rule not applied) that occurred. Rates include acute injuries and injury-related musculoskeletal conditions as described above. Rates were also computed for lower extremity overuse (LEOU) injuries (see Appendix B for ICD-9-CM codes). Rates for all Army Soldiers were adjusted to remove deployment-related injuries and deployment time; trainee rates were not adjusted for deployment.

(6) Causes of injury hospitalizations are coded at the military treatment facility using the coding scheme outlined in the North Atlantic Treaty Organization (NATO) Standardization Agreement (STANAG) No. 2050, 5th Edition.[11] The coding system is employed for coding all injury hospitalizations in the Military Health System. The STANAG codes are four-digit codes describing the intent/situation of the injury incident, injury cause, and location at which the injury occurred. This report includes injury hospitalizations coded as "accidental" (a STANAG trauma code, or first digit, of 5-9), hereafter referred to as unintentional injuries. The distribution of the cause of injury (second through fourth digits of STANAG code) is presented.[12]

(7) Injury matrices (Barell[13] and injury-related musculoskeletal conditions[14]) were used to further describe acute injuries and injury-related musculoskeletal conditions. The matrices report ICD-9-CM code frequencies by type of injury (listed horizontally, across the top of the chart) and body region (listed vertically, along the left side of the chart). Appendices C and D show the corresponding ICD-9-CM codes represented in each cell of the matrices.

b. Army Injury Epidemiology Project Summaries 2007: Analyses, Investigations, and Evaluations. The second section of this report documents epidemiologic analyses, field

investigations, and program evaluations completed by the USACHPPM Injury Prevention Program in 2007.

(1) A summary of findings from select epidemiologic analyses and program evaluations, including USACHPPM technical reports and presentations for calendar year 2007, is presented. Abstracts are displayed with authors and references listed, followed by key figures and/or tables.

(2) A list of citations for all non-deployment related epidemiologic analyses, field investigations, and program evaluations completed in 2007 by the USACHPPM IPP is also provided.

6. RESULTS.

a. Army Injury Surveillance Summary: Deaths, Hospitalizations, and Outpatient Visits. This section summarizes medical surveillance data on injuries affecting non-deployed Active Duty U.S. Army Soldiers.

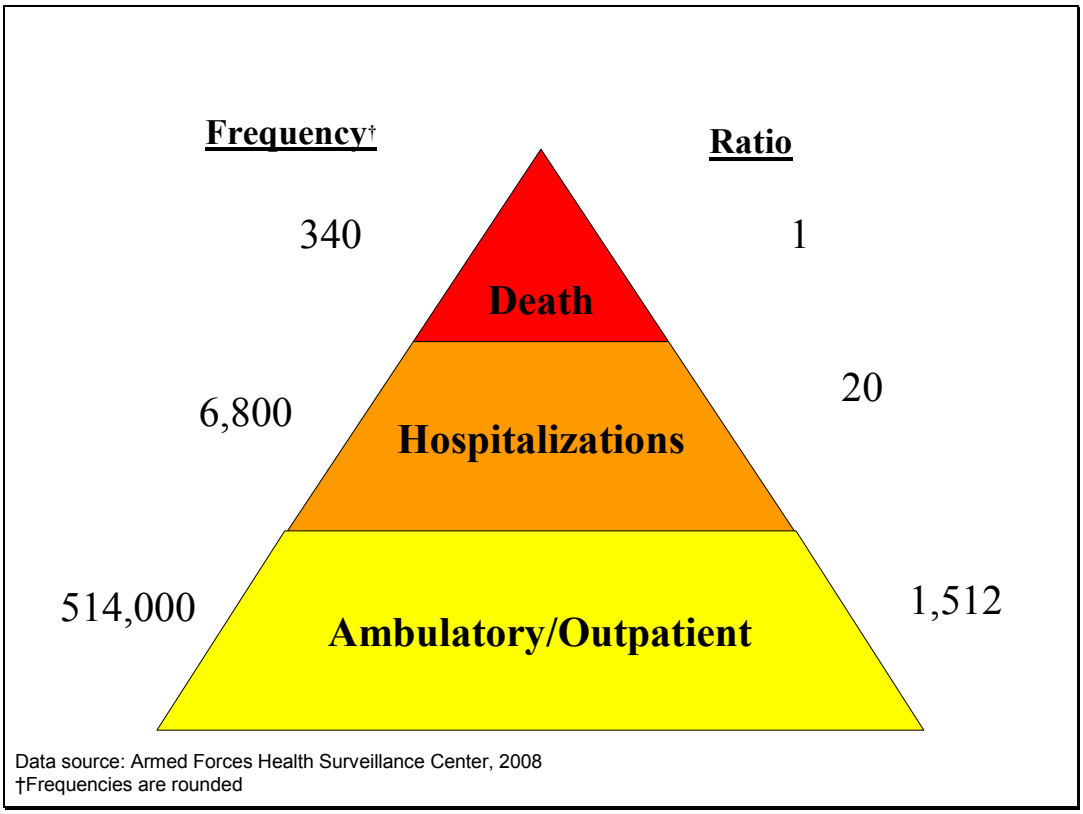


Figure 1. Injury Pyramid, U.S. Army Active Duty, 2007

Figure 1. Notes and Comments—

- Figure 1 provides a summary of injury casualties for 2007.

Figure 1. Notes and Comments (continued)—

- In 2007, there were approximately:
  - 340 injury-related deaths (includes accidental deaths, homicides, and suicides).
  - 6,800 injury-related hospitalizations (includes acute injury and injury-related musculoskeletal conditions).
  - 514,000 injury-related outpatient visits (includes acute injury and injury-related musculoskeletal conditions).
- For every 1 injury-related death, there were 20 hospitalizations and 1,512 outpatient visits.
- Fatalities have been a major focus of injury prevention activities in the past. As illustrated by these data, however, there are far more injury-related hospitalizations and outpatient visits that occur than deaths. These non-fatal outcomes result in a significant lost-duty-time and manpower losses for the Army.

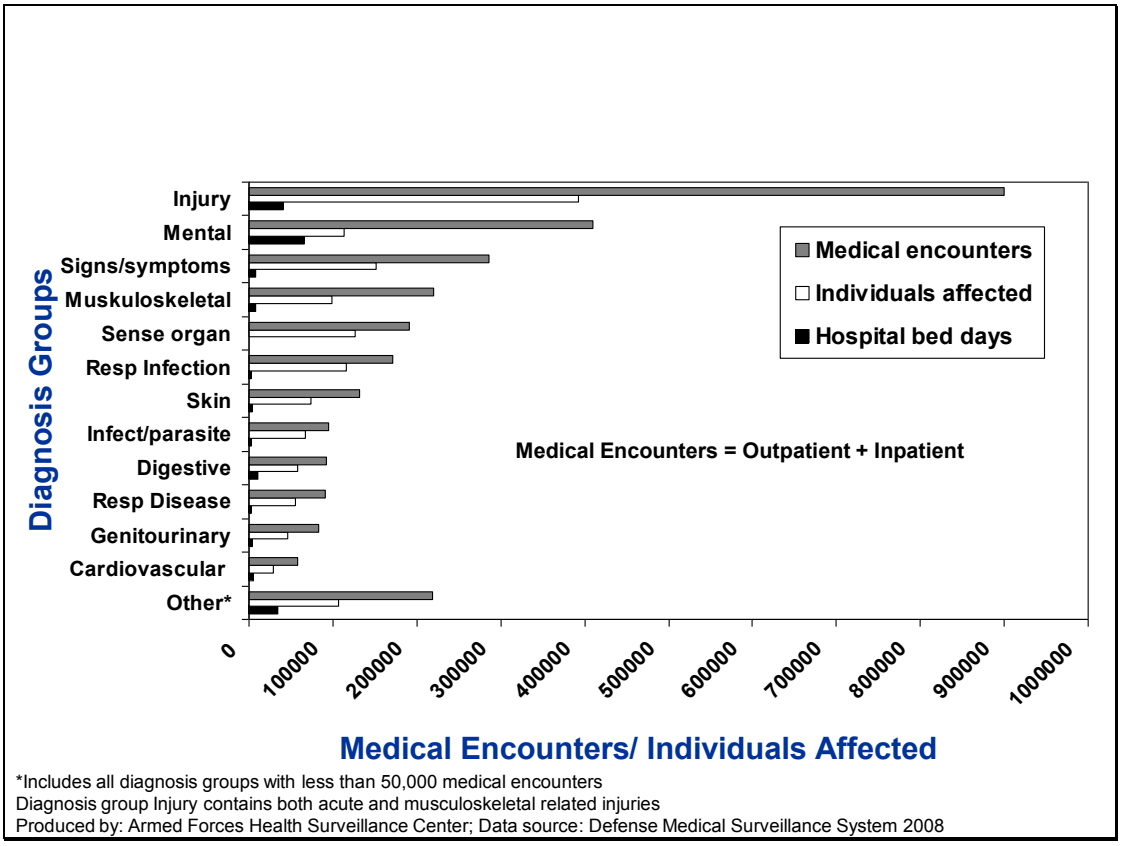


Figure 2. Burden of Injuries and Diseases, U.S. Army Active Duty, 2007

Figure 2. Notes and Comments—

- Figure 2 illustrates the relative impact of injuries and diseases in terms of total medical encounters, the number of individuals affected, and total hospital bed-days for each major diagnosis group in 2007.
- In 2007, there were 2,945,890 medical encounters (hospitalizations and outpatient visits) for U.S. Army personnel.
  - Injuries accounted for 30.5% of all medical encounters (n=899,381), more than twice as many encounters as the second leading cause, mental disorders (n=409,670, 13.9%).
  - Injuries affected 392,246 Soldiers (27%), over 2.5 times more individuals than the second leading diagnosis group, ill-defined signs and symptoms (n= 151,600, 10.6%).
  - Mental disorders (n=66,211) required the most hospital bed days followed by Injury (n=40,276).

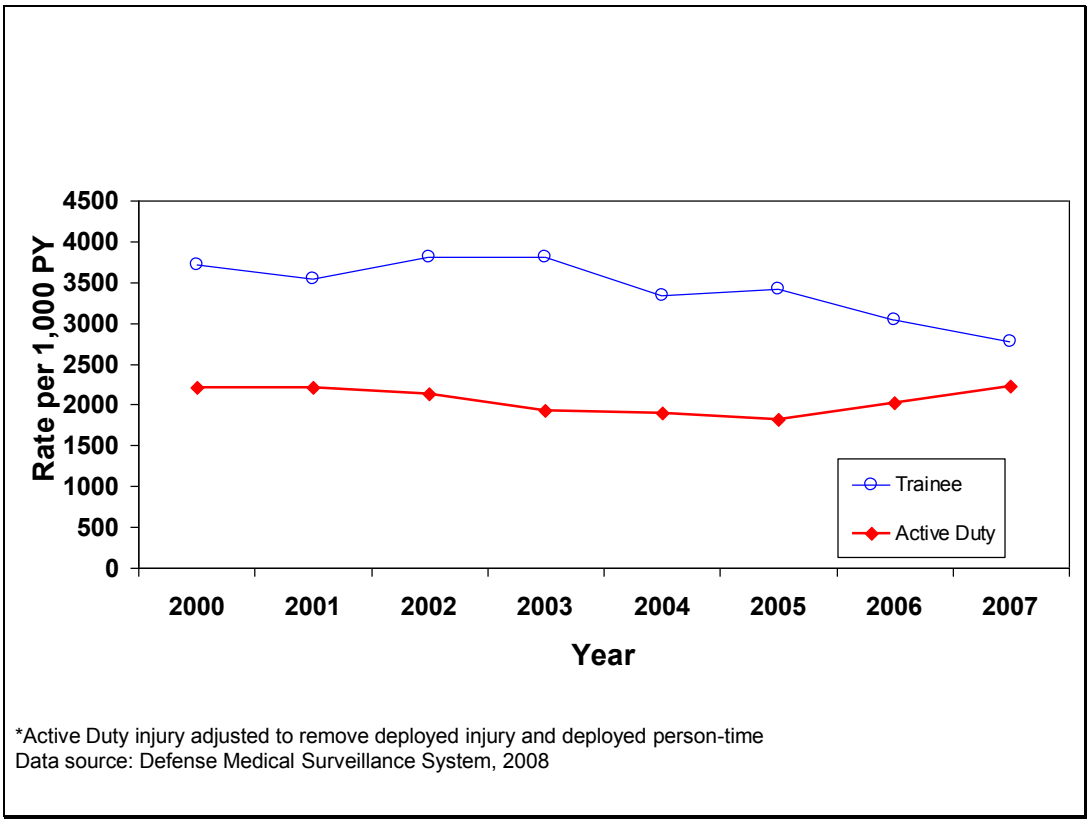


Figure 3. U.S. Army Active Duty vs. Trainee Overall Injury Visit Rates, 2000–2007*

Figure 3. Notes and Comments—

- Figure 3 compares rates of all injury visits among non-deployed Active Duty Soldiers and trainees from 2000–2007.
- The Active Duty injury visit rate declined slightly from 2000 to 2005, and then increased in recent years (22.8% from 2005 to 2007).
- The trainee injury visit rate decreased 27.2% from 3,807 visits per 1,000 person-years in 2003 to 2,770 visits per 1,000 person-years in 2007.
- The decrease in Army trainee injury visit rates may be attributable to the standardized physical training program implemented by the U.S. Army Training and Doctrine Command (TRADOC) in 2003.[15,16]

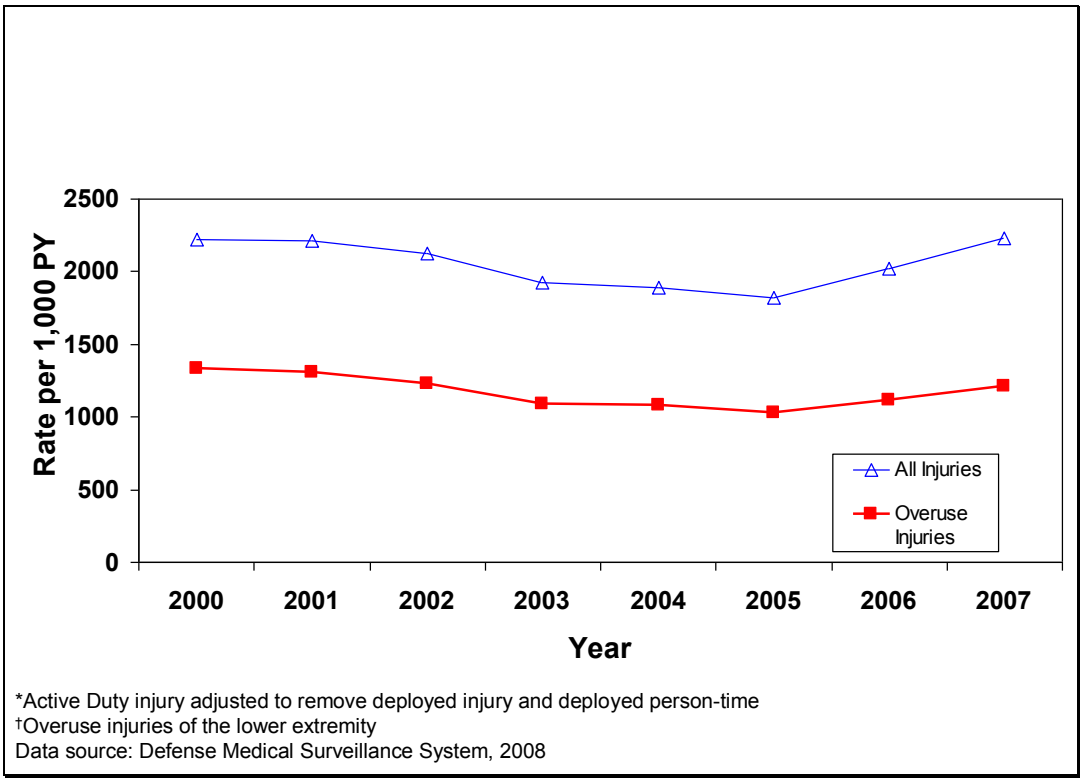


Figure 4. U.S. Army Active Duty Injury and Overuse Injury† Visit Rates, 2000–2007*

Figure 4. Notes and Comments—

- Figure 4 illustrates rates of all injury visits among non-deployed Active Duty Soldiers from 2000–2007.
- Injury visit rates have been consistently over 1,800 visits per 1,000 Soldiers per year.
- Trends in overuse injury visit rates mirrored overall injury visit rates over the last seven years, decreasing from 1,334 per 1,000 person-years in the year 2000 to 1,031 per 1,000 person- years in 2005, and then steadily increasing to 1,210 per 1,000 person-years in 2007. The rates are still considered high, exceeding over 1,000 injury visits per 1,000 person-years during this timeframe.
- During 2000-2007, over half of all injury visits were lower extremity overuse injuries. Many of these injuries (25-50%) are due to weight-bearing activities such as running and marching.[17-20]

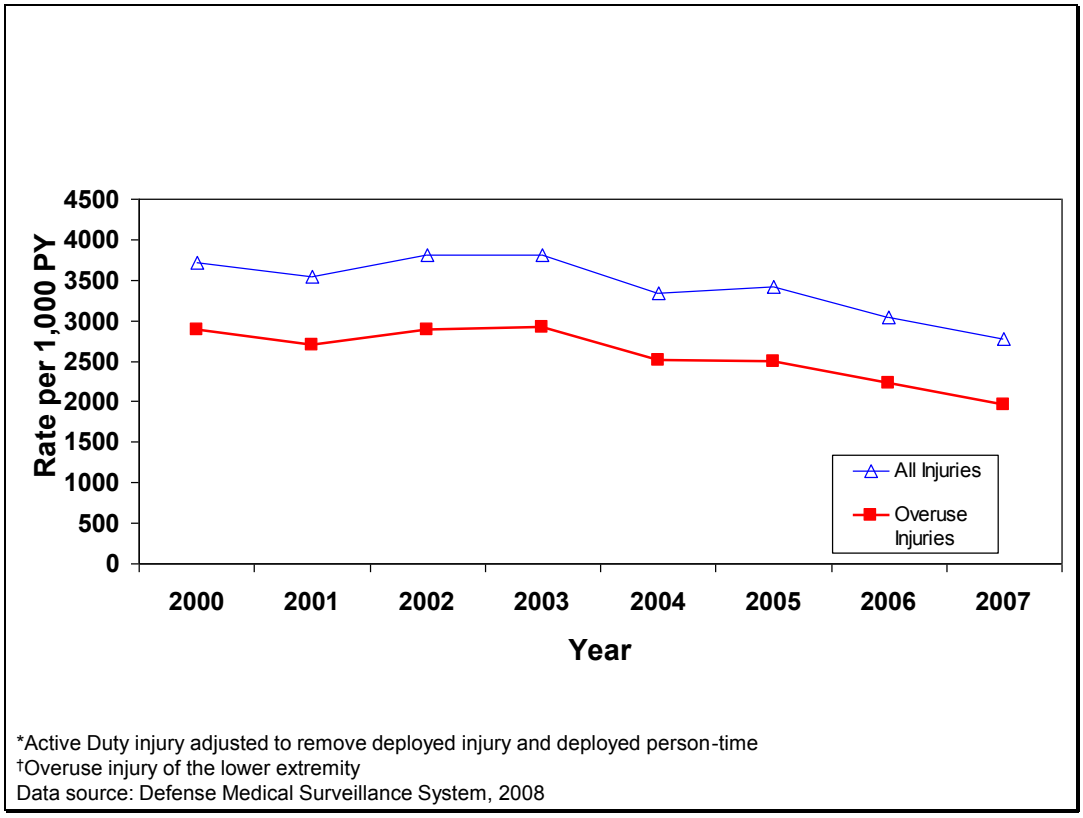


Figure 5. U.S. Army Trainee Injury and Overuse Injury† Visit Rates, 2000–2007*

Figure 5. Notes and Comments—

- Figure 5 illustrates rates of all injury visits among Army trainees from 2000–2007.
- The injury visit rate has decreased 27.2% from 3,807 visits per 1,000 person-years in 2003 to 2,770 visits per 1,000 person-years in 2007.
- Both _overuse injury' rates and _all injury' rates began a steady decrease in 2003. These decreases may be attributable to the standardized physical training program implemented by TRADOC in 2003.[15, 16]
- Trainee overuse injury visit rates have decreased 32.2% over the last seven years, from 2,886 visits per 1,000 person-years in 2000 to 1,957 visits per 1,000 person-years in 2007.

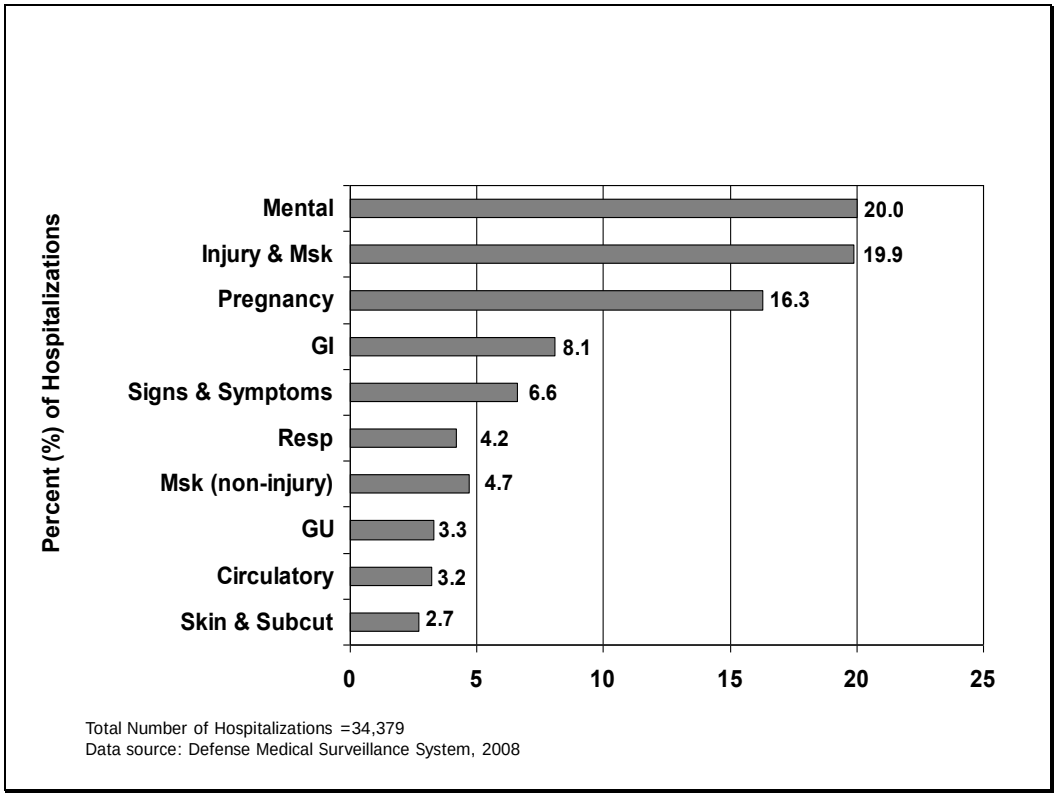


Figure 6. Injuries vs. Illnesses Resulting in Hospitalization, Top 10 ICD-9 Categories, U.S. Army Active Duty, 2007

Figure 6. Notes and Comments—

- Figure 6 illustrates the proportion of hospital admissions by major ICD-9-CM diagnosis groups in 2007.
- Out of 34,379 hospitalizations, three diagnoses groups accounted for 56.2% of all admissions: mental disorders (20.0%), injury and injury-related musculoskeletal conditions (19.9%), pregnancy-related conditions (16.3%).
- Acute injuries and injury-related musculoskeletal conditions accounted for 14.2% and 5.7% of hospitalizations, respectively.
- In 2007, for the first time, mental disorders surpassed injuries as a leading cause of hospitalizations.

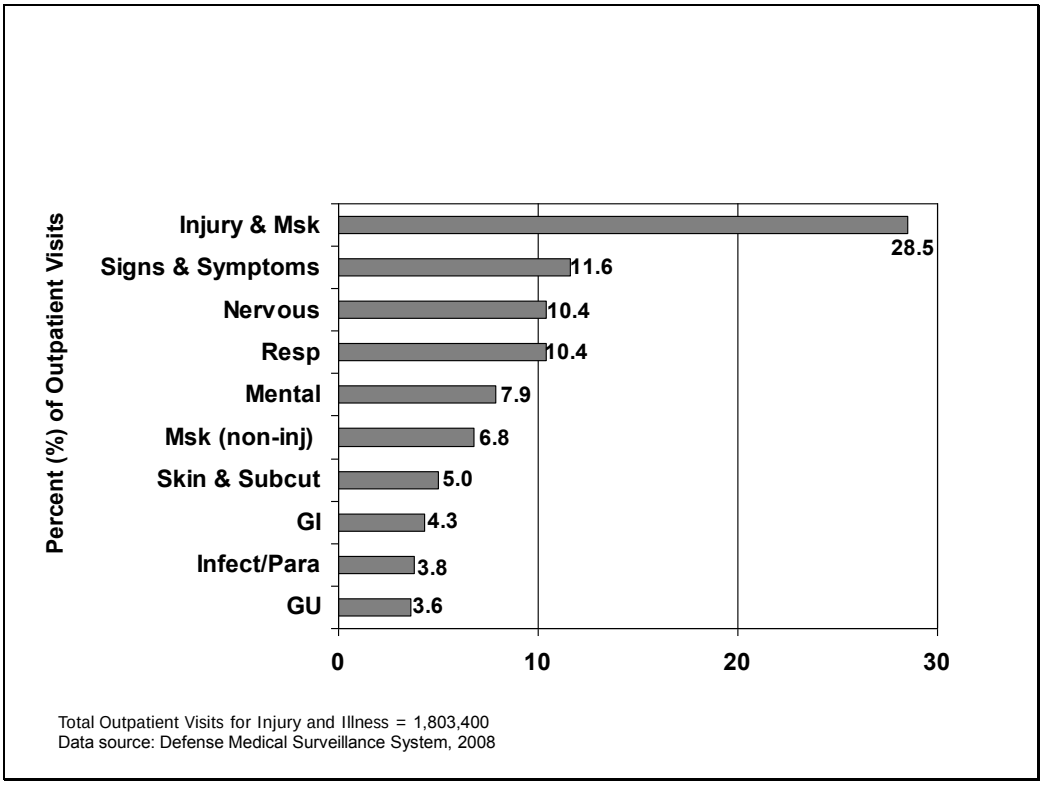


Figure 7. Injuries vs. Illnesses Resulting in Outpatient Visits, Top 10 ICD-9 Categories, U.S. Army Active Duty, 2007

Figure 7. Notes and Comments—

- Figure 7 illustrates the proportion of outpatient visits by major diagnosis groups in 2007.
- A total of 1,803,400 outpatient visits were made by Active Duty Army personnel; 514,083 were injury-related.
- Injuries and injury-related musculoskeletal conditions were responsible for 28.5% of outpatient visits, followed by ill-defined signs and symptoms (11.6%), nervous system conditions (10.4%) and respiratory conditions (10.4%).
- Acute injuries and injury-related musculoskeletal conditions accounted for 12.9% and 15.6% of outpatient visits, respectively.

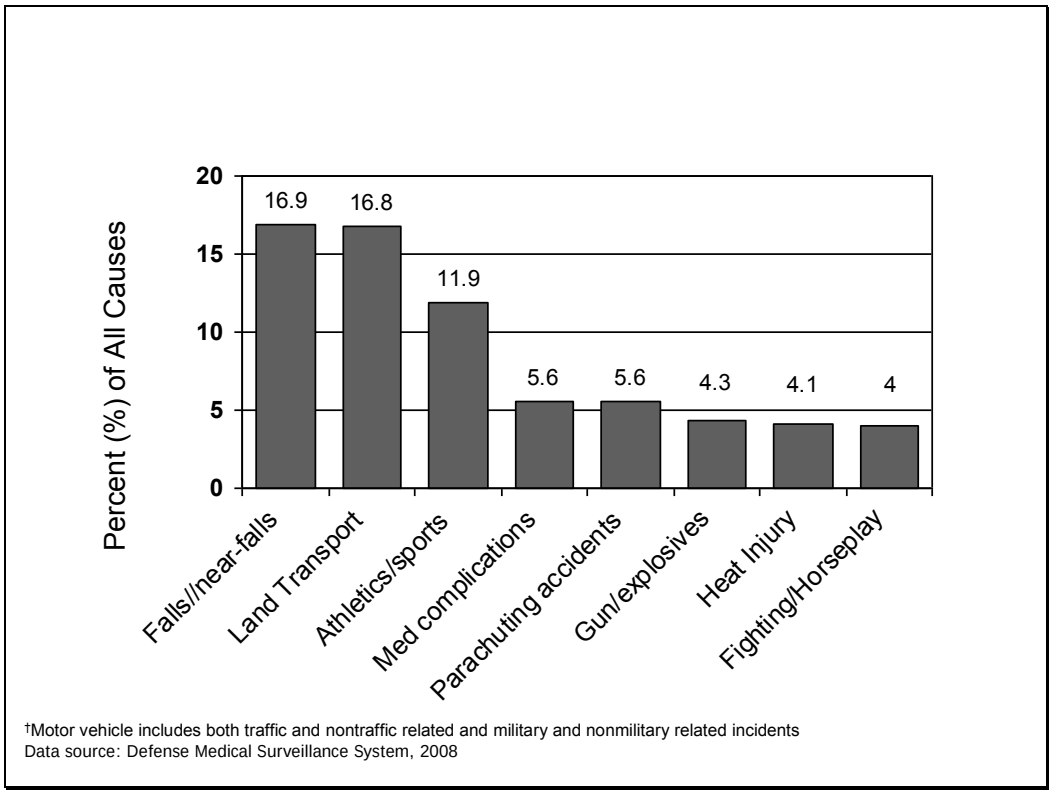


Figure 8. Leading Causes of Unintentional Injury Hospitalizations by STANAG Code Groupings, U.S. Army Active Duty, 2007†

Figure 8. Notes and Comments—

- Figure 8 illustrates the distribution of the leading causes of unintentional injury hospitalizations by specific NATO STANAG 2050 injury cause codes.(11)
- 16.9% of unintentional injury hospitalizations were caused by falls (12.4%) or near-falls (twists, slips, trips or turns–4.5%).
- 16.3% of unintentional injury hospitalizations were due to land transport accidents. Land transport-related hospitalizations were, more specifically, attributed to the following: non-military vehicle accidents (12.3%), military vehicle accidents (1.8%), motor vehicle non-traffic accidents (2.1%), other land transport (0.6%). While land transport-related injuries include accidents involving bicycles and railways, the majority of these injuries were linked to motor vehicles.
- 11.9% of unintentional injury hospitalizations were due to sports. The leading causes of sports-related injury hospitalizations were as follows: basketball (2.3% of all injury hospitalizations), football (2.1%), wrestling/judo (1.1%).

Figure 8. Notes and Comments (continued)—

- Current intervention strategies to address many of these issues are as follows:
  - Motor vehicle accidents,
  - Seatbelt use,[21-23]
  - Lower blood alcohol concentration (BAC) laws,[24]
  - Increased legal drinking age,[24]
  - Sports,
  - Ankle braces,[25-29]
  - Breakaway baseball and softball bases,[30]
  - Mouthguards for football, basketball,[31]
  - Protective eyewear[,32-34]
  - Helmets,[35]
  - Parachuting,
  - Ankle braces.[36-38]
- Other leading causes of unintentional injury such as slips, trips, and falls require more research to determine effective interventions.

Table 1. Frequency of Acute Injuries by Location and Diagnosis (Barell Matrix), U.S. Army Active Duty Hospitalizations, 2007

BODY REGION				DIAGNOSIS														Total	% by body region
				Fracture	Dislocation	Sprains/Strains	Internal	Open Wound	Amputations	Blood Vessel	Contusion/ Superficial	Crush	Burns	Nerves	Unspec	System-wide & late effects			
	Head and Neck	Traumatic Brain Injury (TBI)*	Type 1 TBI	63	0	0	176	0	0	0	0	0	0	0	0	0		239	
			Type 2 TBI	21	0	0	126	0	0	0	0	0	0	0	0	0		147	
			Type 3 TBI	5	0	0	0	0	0	0	0	0	0	0	0	0		5	10.3%
		Other Head, Face, Neck	Other head	0	0	0	0	14	0	0	0	0	1	3	41	0		59	
			Face	209	2	0	0	36	0	0	0	0	1	0	0	0		248	
			Eye	0	0	0	0	11	0	0	7	0	0	0	0	0		18	
			Neck	0	0	0	0	11	0	0	0	0	1	1	0	0		13	
			Head, Face, Neck Unspec.	0	0	0	0	0	0	1	21	0	10	1	7	0		40	10.0%
	Spine and Back	Spinal Cord (SCI)	Cervical SCI	11	0	0	6	0	0	0	0	0	0	0	0	0		17	
			Thoracic/Dorsal SCI	8	0	0	1	0	0	0	0	0	0	0	0	0		9	
			Lumbar SCI	3	0	0	0	0	0	0	0	0	0	0	0	0		3	
			Sacrum Coccyx SCI	0	0	0	0	0	0	0	0	0	0	0	0	0		0	
			Spine, Back Unspec. SCI	0	0	0	13	0	0	0	0	0	0	0	0	0		13	1.1%
		Vertebral Column (VCI)	Cervical VCI	35	8	17	0	0	0	0	0	0	0	0	0	0		60	
			Thoracic/Dorsal VCI	21	0	1	0	0	0	0	0	0	0	0	0	0		22	
			Lumbar VCI	47	4	2	0	0	0	0	0	0	0	0	0	0		53	
			Sacrum Coccyx VCI	9	1	0	0	0	0	0	0	0	0	0	0	0		10	
			Spine, Back Unspec. VCI	4	0	0	0	0	0	0	0	0	0	0	0	0		4	3.9%
	Torso	Torso	Chest (thorax)	21	0	0	67	7	0	3	6	0	2	0	0	0		106	
			Abdomen	0	0	0	64	10	0	0	3	0	2	0	0	0		79	
			Pelvis, Urogenital	36	1	1	3	9	0	1	2	0	2	0	0	0		55	
			Trunk	2	0	0	0	2	0	0	3	0	0	1	11	0		19	
			Back, Buttock	0	0	4	0	7	0	0	12	0	1	0	0	0		24	7.5%
	Extremities	Upper	Shoulder, Upper Arm	77	34	99	0	7	0	0	1	0	2	0	9	0		229	
			Forearm, Elbow	100	3	3	0	20	1	0	2	1	3	0	0	0		133	
			Wrist, Hand, Fingers	112	6	10	0	84	19	0	2	7	10	0	8	0		258	
			Other & Unspec.	9	0	0	0	1	0	4	7	1	1	13	2	0		38	17.4%
		Lower	Hip	41	4	10	0	0	0	0	3	0	0	0	0	0		58	
			Upper leg, Thigh	60	0	0	0	0	6	0	2	0	1	0	0	0		69	
			Knee	13	50	149	0	0	0	0	1	0	2	0	0	0		215	
			Lower leg, Ankle	367	5	53	0	0	4	0	3	2	2	0	0	0		436	
			Foot, toes	71	5	0	0	23	4	0	6	3	2	0	0	0		114	
			Other & Unspec.	7	0	28	0	60	3	5	6	1	2	0	24	0		136	27.2%
	Unclass. by Site	Other, Unspecified	Other/Multiple	0	0	0	0	0	0	1	0	0	0	5	0	0		6	0.2%
			Unspec. Site	6	3	10	5	14	0	0	18	0	9	5	59	0		129	3.4%
		System-wide & late effects		0	0	0	0	0	0	0	0	0	0	0	0	718		718	19.0%
		Total		1,358	126	387	461	316	37	15	105	15	54	29	161	718		3,782	100%
		% Total		35.9%	3.3%	10.2%	12.2%	8.4%	1.0%	0.4%	2.8%	0.4%	1.4%	0.8%	4.3%	19.0%		100%	

*For purposes of classification, head injuries are labeled as Type 1 TBI if there is recorded evidence of an intracranial injury or a moderate or a prolonged loss of consciousness (LOC) or injuries to the optic nerve pathways. Type 2 includes injuries with no recorded evidence of intracranial injury, and LOC of less than one hour, or LOC of unknown duration, or unspecified level of consciousness. Type 3 TBI includes patients with no evidence of intracranial injury and no LOC.

Prepared by USACHPPM Injury Prevention Program and Armed Forces Health Surveillance Center

Data source: Defense Medical Surveillance System, 2008

Table 1. Notes and Comments—

- Table 1 uses the Barell Matrix to categorize acute injuries that required hospitalization by injury type and body region.
- In 2007, there were 3,782 acute and traumatic injuries (coded in the 800-900 ICD-9-CM code series) requiring hospitalization.
- The most common types of injury leading to hospital admission were fractures (35.9%), internal injuries (12.2%), and sprains/strains (10.2%).
- Injured body regions most commonly leading to hospitalization were lower extremities (27.2%), traumatic brain injuries (TBI) (10.3%), and other head, face and neck injuries (10.0%).
- Leading specific reasons for hospitalizations included fractures of the lower leg and/or ankle (9.7%), fractures of the face (5.5%), and internal head wounds (Type 1 traumatic brain injury) (4.7%).

Table 2. Frequency of Acute Injuries by Location and Diagnosis (Barell Matrix), U.S. Army Active Duty Outpatient Visits, 2007

BODY REGION				DIAGNOSIS																	
				Fracture	Dislocation	Sprains/Strains	Internal	Open Wound	Ampu-tations	Blood Vessel	Contusion/ Superficial	Crush	Burns	Nerves	Unspec	System-wide & late effects	Total	% by body region
	Head and Neck	Traumatic Brain Injury (TBI)*	Type 1 TBI	93	0	0	1,266	0	0	0	0	0	0	0	0	0	1,359	
			Type 2 TBI	145	0	0	3,221	0	0	0	0	0	0	0	0	0	3,366	
			Type 3 TBI	32	0	0	0	0	0	0	0	0	0	0	0	0	32	2.1%
		Other Head, Face, Neck	Other head	0	0	0	0	1,292	0	0	0	0	13	32	2,397	0	3,734	
			Face	1,535	37	63	0	3,410	0	0	0	0	47	0	0	0	5,092	
			Eye	0	0	0	0	350	0	0	3,949	0	135	29	0	0	4,463	
			Neck	1	0	0	0	82	0	0	0	7	45	14	0	0	149	
			Head, Face, Neck Unspec.	0	0	0	0	0	0	21	3,425	16	139	4	1,049	0	4,654	8.0%
	Spine and Back	Spinal Cord (SCI)	Cervical SCI	42	0	0	52	0	0	0	0	0	0	0	0	0	94	
			Thoracic/Dorsal SCI	68	0	0	15	0	0	0	0	0	0	0	0	0	83	
			Lumbar SCI	28	0	0	27	0	0	0	0	0	0	0	0	0	55	
			Sacrum Coccyx SCI	1	0	0	4	0	0	0	0	0	0	0	0	0	5	
			Spine, Back Unspec. SCI	5	0	0	47	0	0	0	0	0	0	0	0	0	52	0.1%
		Vertebral Column (VCI)	Cervical VCI	151	20	6,603	0	0	0	0	0	0	0	0	0	0	6,774	
			Thoracic/Dorsal VCI	231	6	2,364	0	0	0	0	0	0	0	0	0	0	2,601	
			Lumbar VCI	316	18	7,976	0	0	0	0	0	0	0	0	0	0	8,310	
			Sacrum Coccyx VCI	106	18	290	0	0	0	0	0	0	0	0	0	0	414	
			Spine, Back Unspec. VCI	71	3	0	0	0	0	0	0	0	0	0	0	0	74	8.0%
	Torso	Torso	Chest (thorax)	598	17	1,478	355	98	0	16	1,739	0	37	3	0	0	4,341	
			Abdomen	0	0	0	198	151	0	7	275	0	22	30	0	0	683	
			Pelvis, Urogenital	297	13	5,602	45	261	0	6	144	19	15	3	0	0	6,405	
			Trunk	6	0	0	0	42	0	0	896	2	22	5	1,364	0	2,337	
			Back, Buttock	0	0	3,046	0	103	0	0	779	2	38	0	0	0	3,968	7.8%
	Extremities	Upper	Shoulder, Upper Arm	1,146	2,778	11,075	0	264	17	0	1,254	17	29	0	870	0	17,450	
			Forearm, Elbow	1,412	110	998	0	733	28	0	912	19	157	0	0	0	4,369	
			Wrist, Hand, Fingers	6,214	570	6,895	0	5,674	120	0	5,384	394	516	0	1,183	0	26,950	
			Other & Unspec.	74	0	0	0	236	11	37	1,011	6	127	556	585	0	2,643	22.6%
		Lower	Hip	317	81	5,353	0	0	0	0	408	3	0	0	0	0	6,162	
			Upper leg, Thigh	454	0	0	0	0	101	0	291	5	35	0	0	0	886	
			Knee	175	4,106	4,515	0	0	0	0	1,847	11	7	0	0	0	10,661	
			Lower leg, Ankle	3,466	69	23,871	0	0	148	0	869	33	77	0	0	0	28,533	
			Foot, toes	3,448	141	3,172	0	969	35	0	5,120	171	73	0	0	0	13,129	
			Other & Unspec.	240	0	20,314	0	1,686	92	45	2,183	8	92	0	3,214	0	27,874	38.4%
	Unclass. by Site	Other, Unspecified	Other/Multiple	31	0	0	0	0	0	0	0	0	3	175	0	0	209	0.1%
			Unspec. Site	381	68	7,591	98	1,591	0	11	8,161	60	859	180	824	0	19,824	8.7%
		System-wide & late effects		0	0	0	0	0	0	0	0	0	0	0	0	9,701	9,701	4.3%
		Total		21,084	8,055	111,206	5,328	16,942	552	143	38,647	773	2,488	1,031	11,486	9,701	227,436	100%
		% Total		9.3%	3.5%	48.9%	2.3%	7.4%	0.2%	0.1%	17.0%	0.3%	1.1%	0.5%	5.1%	4.3%	100%	

*For purposes of classification, head injuries are labeled as Type 1 TBI if there is recorded evidence of an intracranial injury or a moderate or a prolonged loss of consciousness (LOC) or injuries to the optic nerve pathways. Type 2 includes injuries with no recorded evidence of intracranial injury, and LOC of less than one hour, or LOC of unknown duration, or unspecified level of consciousness. Type 3 TBI includes patients with no evidence of intracranial injury and no LOC.

Prepared by USACHPPM Injury Prevention Program and Armed Forces Health Surveillance Center

Data source: Defense Medical Surveillance System, 2008

Table 2. Notes and Comments—

- Table 2 uses the Barell Matrix to categorize outpatient visit injuries by injury type and body region affected.
- In 2007, 227,436 acute injuries (coded in the 800-900 ICD-9-CM code series) required an outpatient hospital visit.
- 48.9% of outpatient visits were the result of sprains/strains, 17.0% were from contusions/superficial wounds, and 9.3% were due to fractures.
- Body regions most affected were lower extremities (38.4%), upper extremities (22.6%), and the vertebral column (8%).
- Leading specific reasons for outpatient visits included strains/sprains to the lower leg and/or ankle (10.5%) and strains/sprains of the shoulder/upper arm (4.9%).
- Many of these injuries are serious and result in a tremendous number days of limited duty (DLD), resulting in reduced readiness and loss of manpower for the Army. Estimates from clinicians and standard sports medicine texts[39] indicate that—
  - Fractures result in an estimated 30-180 DLD per injury.
  - Dislocations result in an estimated 30-100 DLD per injury.
  - Sprains/strains result in an estimated 7-30 DLD per injury.
- While fractures only account for 9% of all outpatient visits, they are estimated to account for 40% of DLD.
- Sprains and/or strains account for 49% of all outpatient visits and are estimated to account for approximately 36% of DLD.
- Dislocations account for 4% of all outpatient visits and are estimated to account for approximately 13% of DLD.

Table 3. Frequency of Injury-related Musculoskeletal Conditions by Location and Diagnosis, U.S. Army Active Duty Hospitalizations, 2007

Injury Location				DIAGNOSIS							
				Inflammation and Pain (Overuse)	Joint Derangement	Joint Derangement with Neurological Involvement	Stress Fracture	Sprains/Strains/ Rupture	Dislocation	Total	% by body region
BODY REGION		Vertebral Column	Cervical	14	145	56	0	0	0	215	
			Thoracic/Dorsal	0	3	14	0	0	0	17	
			Lumbar	65	376	26	0	0	0	467	
			Sacrum, Coccyx	2	0	0	0	0	0	2	
			Spine, Back Unspecified	50	34	5	1	0	0	90	41.8%
	Extremities	Upper	Shoulder	110	102	0	0	7	62	281	
			Upper arm, Elbow	21	3	0	0	0	0	24	
			Forearm, Wrist	3	8	0	0	0	1	12	
			Hand	2	3	0	0	0	1	6	17.1%
		Lower	Pelvis, Hip, Thigh	24	31	0	1	1	2	59	
			Knee, Lower leg	81	135	0	2	278	5	501	
			Ankle, Foot	41	92	0	0	3	3	139	37.0%
	Unclassified by Site	Others and Unspecified	Other specified/Multiple	1	2	0	0	0	0	3	
			Unspecified Site	27	2	3	41	2	0	75	4.1%
	Total			441	936	104	45	291	74	1,891	100%
	% Total			23.3	49.5	5.5	2.4	15.4	3.9		

Prepared by USACHPPM Injury Prevention Program and Armed Forces Health Surveillance Center
Data source: Defense Medical Surveillance System, 2008

Table 3. Notes and Comments—

- Table 3 categorizes injury-related musculoskeletal conditions that required hospitalization by injury type and body region affected.
- In 2007, 1,891 hospitalizations due to injury-related musculoskeletal conditions occurred.
- The most common types of injury-related musculoskeletal conditions leading to hospital admission were joint derangement (49.5%), inflammation and pain (overuse) (23.3%) and sprains/strains/ruptures (15.4%).
- The spine/back (41.2%) was the body region most affected by injury-related musculoskeletal conditions, followed by lower extremities (37.0%) and upper extremities (17.1%).
- The leading specific injury-related musculoskeletal conditions were joint derangements of the lumbar spine (19.9%), sprains/strains to the knee and/or lower leg (14.7%), and joint derangements of the cervical spine (7.7%).

Table 4. Frequency of Injury-related Musculoskeletal Conditions by Location and Diagnosis, U.S. Army Active Duty Outpatient Visits, 2007

Injury Location				DIAGNOSIS							
				Inflammation and Pain (Overuse)	Joint Derangement	Joint Derangement with Neurological Involvement	Stress Fracture	Sprains/Strains/ Rupture	Dislocation	Total	% by body region
BODY REGION		Vertebral Column	Cervical	11,538	1,580	1,971	0	0	0	15,089	
			Thoracic/Dorsal	0	179	2,763	0	0	0	2,942	
			Lumbar	42,842	5,732	2,044	0	0	0	50,618	
			Sacrum, Coccyx	1,743	0	0	0	0	0	1,743	
			Spine, Back Unspecified	18,752	2,190	229	78	0	0	21,249	32.8%
	Extremities	Upper	Shoulder	27,056	1,849	0	0	909	637	30,451	
			Upper arm, Elbow	4,967	66	0	6	0	4	5,043	
			Forearm, Wrist	5,516	214	0	8	0	15	5,753	
			Hand	2,994	60	0	0	172	15	3,241	15.9%
		Lower	Pelvis, Hip, Thigh	11,080	190	0	59	76	1	11,406	
			Knee, Lower leg	59,719	6,018	0	1,760	2,828	101	70,426	
			Ankle, Foot	42,725	2,392	0	615	109	48	45,889	45.8%
	Unclassified by Site	Others and Unspecified	Other specified/Multiple	1,092	50	0	112	37	3	1,294	
			Unspecified Site	8,958	70	1,218	3,590	115	1	13,952	5.5%
	Total			238,982	20,590	8,225	6,228	4,246	825	279,096	100%
	% Total			85.6	7.4	2.9	2.2	1.5	0.3		

Prepared by USACHPPM Injury Prevention Program and Armed Forces Health Surveillance Center
Data source: Defense Medical Surveillance System, 2008

Table 4. Notes and Comments—

- Table 4 categorizes injury-related musculoskeletal conditions that resulted in an outpatient visit by injury type and body region affected.
- In 2007, 279,096 outpatient visits occurred (coded in the 710-739 ICD-9-CM code series).
- Most outpatient visits were due to inflammation and pain (overuse) (85.6%), followed by joint derangement (7.4%) and joint derangement with neurological involvement (2.9%).
- Lower extremities (45.8%) were the body region most affected by injury-related musculoskeletal conditions, followed by the spine/back (32.8%) and upper extremities (15.9%).
- The leading specific injury-related musculoskeletal conditions were inflammation and pain (overuse) to the knee and/or lower leg (21.4%), inflammation and pain (overuse) to the lumbar spine (15.4%), and inflammation and pain (overuse) to the ankle and/or foot (15.3%)
- Many outpatient injury-related musculoskeletal conditions are serious and can result in a tremendous number of DLD, resulting in loss of man power for the Army.[39]
    - Stress fractures account for an estimated 75 DLD per injury.
    - Joint derangements accounts for an estimated 21 DLD per injury.
    - Dislocations account for an estimated 30 DLD per injury.
    - Inflammation and pain (overuse), joint derangement with neurological involvement and sprains/strains account for an estimated 14 DLD per injury.
- Inflammation and pain (overuse) diagnoses account for 86% of all injury-related musculoskeletal condition outpatient visits and an estimated 75% of DLD.
- Stress fractures only account for 2% of all injury-related musculoskeletal condition outpatient visits, yet they account for an estimated 11% of DLD.
- Joint derangements accounts for 8% of all injury-related musculoskeletal condition outpatient visits and an estimated 10% of all DLD.

b. Army Injury Epidemiology Project Summaries 2007: Analyses, Investigations, and Evaluations. This section features a summary of non-deployment findings completed by the USACHPPM Injury Prevention Program in 2007.

(1) USACHPPM. 2007. *The Recruit Assessment Program and Predictors of Injury in U.S. Army Basic Combat Training.* (Prepared by: Hauret, KG, Canada S, Canham-Chervak, M. and Jones BH. 2007. Presented at the Annual Force Health Protection Conference.)

Injury incidence during 9-week Army BCT has ranged from 19 percent to 37 percent for men and 42 percent to 67 percent for women. Numerous risk factors for injury in BCT have been identified, including low prior physical activity, low physical fitness, higher running mileage, older running shoes, and smoking. The purpose of this analysis was to evaluate potential risk factors for injury during BCT from self-reported health status and health risk behaviors included in the pilot Recruit Assessment Program survey during FY 2003. In FY2003, 22,156 Army recruits completed a Recruit Assessment Program questionnaire that measured behavioral and social protective and risk factors including childhood and adult exposures (e.g., abuse and secondhand smoke), physical and mental functioning, health-risk behaviors (e.g., tobacco and alcohol use), and social support. Questionnaire responses were matched with personnel and medical data containing demographic, deployment, and injury information. A theory-based conceptual model was used to guide analyses of predictors of injury in BCT. Multivariate analysis and logistic regression were used to identify factors associated with injury during both timeframes. Overall, 26% of male recruits in the study population were injured compared to 52% of female recruits during BCT at Fort Jackson in FY 2003. Based on univariate analysis, the number of cigarette packs smoked daily was associated with BCT injury for both male and female recruits. In multivariate modeling (Table 5), number of cigarette packs smoked daily among female recruits was an independent risk factor for BCT injury. Age at onset of smoking was a stronger independent risk factor for BCT injury among male recruits than the number of packs smoked. Less frequent participation in sport/activity was associated with a higher probability of BCT injury among female recruits. Additional independent BCT injury risk factors were identified in the multivariate analysis, including: older age, higher BMI, and lower education for both male and female recruits; white race; history of being assaulted or impacted by emotional health; early onset of smoking; stiff/painful joints for male recruits; multiple family relocations as a child; fewer close friends/relatives; treated for on-the-job injury; missed work due to injury; less physically active; and higher number of cigarette packs smoked daily for female recruits.

Table 5. Independent Risk Factors for Injury during Basic Combat Training: Results of Multivariate Survival Analysis Model by Gender, Recruit Assessment Program Pilot Study participants, Fort Jackson, 2003*

Domain	Female—Active Duty		Males—Active Duty	
	Risk Factor	P-Value	Risk Factor	P-Value
Demographics	BMI quartiles (highest)	0.0123	BMI quartiles (highest)	0.2319
	Where do you live most of the time? (moved a lot)	0.0175	Native American or Alaska Native	0.0082
	Marital status (divorced or married vs. single)	0.0003	White (Caucasian)	0.0006
	Age group (≥23 years)	0.0551	Age group (≥23 years)	0.0001
	Education level (GED or no high school)	0.0447	Education level (GED or no high school)	0.0135
	Army Fitness Qualification Test (AFQT) percentile categories (lower vs. higher)	0.0833	Number Dependents (2 vs. none)	0.0039
			Prior Military service	0.0389
Childhood Environment			Amount a parent living with you pushed, shoved, grabbed, or slapped you	0.0847
			You were seriously attacked, beaten up or assaulted	0.0219
Childhood Socioeconomic Status			Fathers furthest education (lower education)	0.092
			Mothers furthest education (higher education)	0.0872
Social Support	# of close friends/relatives to call for help/personal problems (less)	0.0041		
Stressors				
Psychological			How often did you feel calm/peaceful in the last year	0.1046
			How often do you get mad enough to hit, kick, or throw things	0.0172
			Did your emotional health cause you to accomplish less than you would have liked	0.0452
Motivation	Join military – family member in the military (yes)	0.0397		
	Join military – 20-yr career in military (yes)	0.0166		
	Join military - other reasons (yes)	0.0092		
Health Status	Treated by doctor or nurse due to being injured on the job	0.0317	Ever had swollen, stiff, or painful joints	<.0001
	Missed >1 day of work – due to injury on the job	0.0745		
	Number of allergies (more)	0.0109		
Behaviors	In a typical week, how often did you participate in a sport activity where you sweated for 20 minutes.	0.0003	Age you started smoking regularly (younger)	0.0004
	# of packs smoked daily when you smoked regularly.	<.0001		

*Results for risk factors with p<0.10 are reported.

(2) USACHPPM 2007. *The Recruitment Assessment Program and Predictors of Attrition in U.S. Army Basic Combat Training.* (Prepared by: Canada S, Canham-Chervak, M, Schmitt C, Strauss W, Buck D, and Hauret K. Presented at the Force Health Protection Conference.)

During the first 6 months of service, approximately 7 percent of recruits are discharged from the Army and another 4 percent within their first 3 years. Research on attrition has historically focused on demographic, psychosocial, and health-related risk factors, including educational level, gender, prior injury, pre-service cigarette use, and physical activity prior to service. The purpose of this analysis was to assess potential predictors of attrition during BCT for incoming recruits who participated in the Recruit Assessment Program pilot survey that was administered at Fort Jackson, South Carolina during FY03 In FY03, 22,156 Army recruits in BCT completed a Recruit Assessment Program questionnaire with assessments of childhood and adult adverse exposures (physical and sexual violence, secondhand smoke), physical and mental functioning, health risk behaviors (tobacco and alcohol use, sedentary lifestyle, and sexual activity), and potential social support (religiosity/social networks). Questionnaire responses were matched with personnel and medical data containing demographic, deployment, attrition, and injury information. Multivariate analysis and logistic regression were used to identify factors associated with attrition during BCT. Overall, attrition for study population (9 percent) was similar to attrition for all recruits at Fort Jackson (10 percent) in FY03. Thirteen percent of female recruits in the study population attrited during BCT compared to 6 percent of male recruits. Consistent with prior studies, the following risk factors were significant predictors of BCT attrition in the multivariate analysis: regular cigarette smoking and lower AFQT for both male and female recruits; previous injury for male recruits; and history of sexual abuse for female recruits (Table 6). This analysis also indicated that self-reported ~~"p~~oor" general health, work and daily activity limitations due to physical health, history of shortness of breath, and citing travel and adventure as reasons for joining the military were associated with higher attrition for both male and female recruits. Days in Physical Training and Rehabilitation Program and number of allergies were also identified as significant predictors of female attrition during BCT. In addition, male recruits with a history of knee trouble were associated with higher BCT attrition.

Table 6. Independent Risk Factors for Attrition during Basic Combat Training: Results of Multivariate Survival Analysis Model by Gender, Recruitment Assessment Program Pilot Study participants, Fort Jackson, 2003*

Domain	Females – Active Duty		Males – Active Duty	
	Label	P-Value	Label	P-Value
Demographic	Not of Hispanic, Latino or Spanish descent	<.0001		
Childhood Enviro	Accident where could have been killed, but not badly hurt	0.0167		
	Saw a stranger being badly injured or killed	0.0183		
	Were you ever raped	0.0192		
	# brothers and sisters raised in the same home with you	0.0036		
Childhood Env SES			Fathers furthest education	0.0978
Social Support	# times attend church/synagogue/religious gathering	0.0608		
Psych Factors	Emotional health cause you to accomplish less than liked	0.0032		
Psych Factors-Motivation	Join military- for travel and adventure	<.0001	Join military- for travel and adventure	0.0158
			Difficulty concentrating- ever had	0.0453
Health Status	Shortness of breath- ever had?	0.0164	Shortness of breath- ever had	0.0402
	General Health Rating	0.0001	General Health Rating	0.0109
	Number of Allergies	0.0004	Knee trouble- ever had	0.0004
	Physical health limit you in work or other daily activities .	0.0028	Physical health limit you in work or other daily activities .	0.0042
			Physical health cause you to accomplish less than liked	0.0012
Behaviors	# cups/bottles/cans of caffeinated drinks on avg. day	0.0936	# cups/bottles/cans of caffeinated drinks on avg. day	0.0076
	# of packs smoked daily when you smoked regularly	0.0031	# of packs smoked daily when you smoked regularly	0.0011
			Alcohol Use DO, AUDIT: Has Alcohol Disorder	0.0083
Aptitude			AFQT Percentile (Categories)	0.0979
			Education level at BCT start	0.0095
Medical Info	Days in PTRP	<.0001	BMI Status	0.0107
			Injury (Y/N)	<.0001

*Results for risk factors with p<0.10 are reported.

(3) USACHPPM. 2007. *Trends of Injury Topics in a Major Military Safety Publication, 1999-2005*. (Prepared by: Canada S, Canham-Chervak, M., and Jones BH. Unpublished)

The U.S. Army safety publication, *Countermeasure*, is a primary means of disseminating safety information and a key resource for Commanders, sergeants, and other leadership who are responsible for monitoring and preventing injuries among their troops on a daily basis. The purpose of this evaluation was to: (1) provide a comprehensive summary of injury topics addressed by a major military safety publication from 1999 to 2005 and to (2) compare the distribution of these articles to the actual causes of hospitalized injuries among Active Duty Army Soldiers during this time period. Latent content analysis was used to sort and group all articles, editorials, and informational pieces contained in the U.S. Army safety publication *Countermeasure* from 1999 to 2005. Twenty-one injury cause categories based on the major categories contained in the standardized injury cause-coding system used to code U.S. military hospitalizations were used to classify the articles. Articles that could not be classified into one of these 21 categories were placed in an ‗other/miscellaneous' category. Data on injury causes for hospitalization were obtained from the DMSS and were summarized according to the same injury case categories as those used in the content analysis. There were 770 articles examined for content. Articles related to military vehicle (traffic) accidents were the most common injury cause (17 percent) addressed in the publication from 1999–2005. Privately owned vehicle (POV) accident was the second most frequently covered injury topic (14 percent). Guns and explosives, machinery/tools, and military vehicle (non-traffic) accidents accounted for 8 percent, 7 percent, and 4 percent of articles in the publication, respectively. Hospitalization data indicated that, in 2005, the top five causes of injury hospitalizations of Active Duty, non-deployed Army troops were POV accidents (7 percent), falls (6 percent), athletics/sports (6 percent), air transport (4 percent), and machinery/tools (3 percent). Two of the top five causes of injury hospitalizations, private vehicle accidents, and machinery/tools are among the top five injury topics covered in *Countermeasure* from 1999 to 2005. However, two of the other top five causes of injury hospitalizations—falls and athletics/sports—ranked 9th and 13th in the list of topics covered in *Countermeasure* from 1999 to 2005. Since *Countermeasure* only addresses ground accidents, air transport was not addressed in the publication and a comparison could not be made. To enhance contributions toward injury prevention, publications that serve as a key means of disseminating safety information should attempt to focus their contents on leading causes of injury as defined by medical surveillance data.

(4) USACHPPM. 2007. *Seasonal Variations in Injury Rates in United States Army Ordnance Training*. (Prepared by: Knapik, JJ, Jones S, and Jones BH. Presented at the Annual Force Health Protection Conference.)

The purpose of this project was to assess the effects of seasons and temperature on injury rates during Ordnance School Training. Injury data were collected from two clinics servicing two geographically separated battalions at the Aberdeen Proving Ground, Maryland. Weekly injury rates were calculated as injured Soldiers divided by the total Soldiers in each battalion. Maximum daily temperatures were obtained from the National Atmospheric and Oceanic Administration. A two-way analysis of variance indicated a significant difference in injury rates by battalion ($p=0.04$) and season ($p<0.01$) but no significant unit by season interaction ($p=0.16$). Summer injury rates were higher than winter or fall rates ($p<0.05$) (Figure 9). Correlations between weekly injury rates and weekly average maximal temperatures were 0.71 and 0.88 for the two battalions. These data support previous work in U.S. Army BCT indicating a seasonal effect on injury rates. Higher environmental temperatures were associated with higher injury rates.

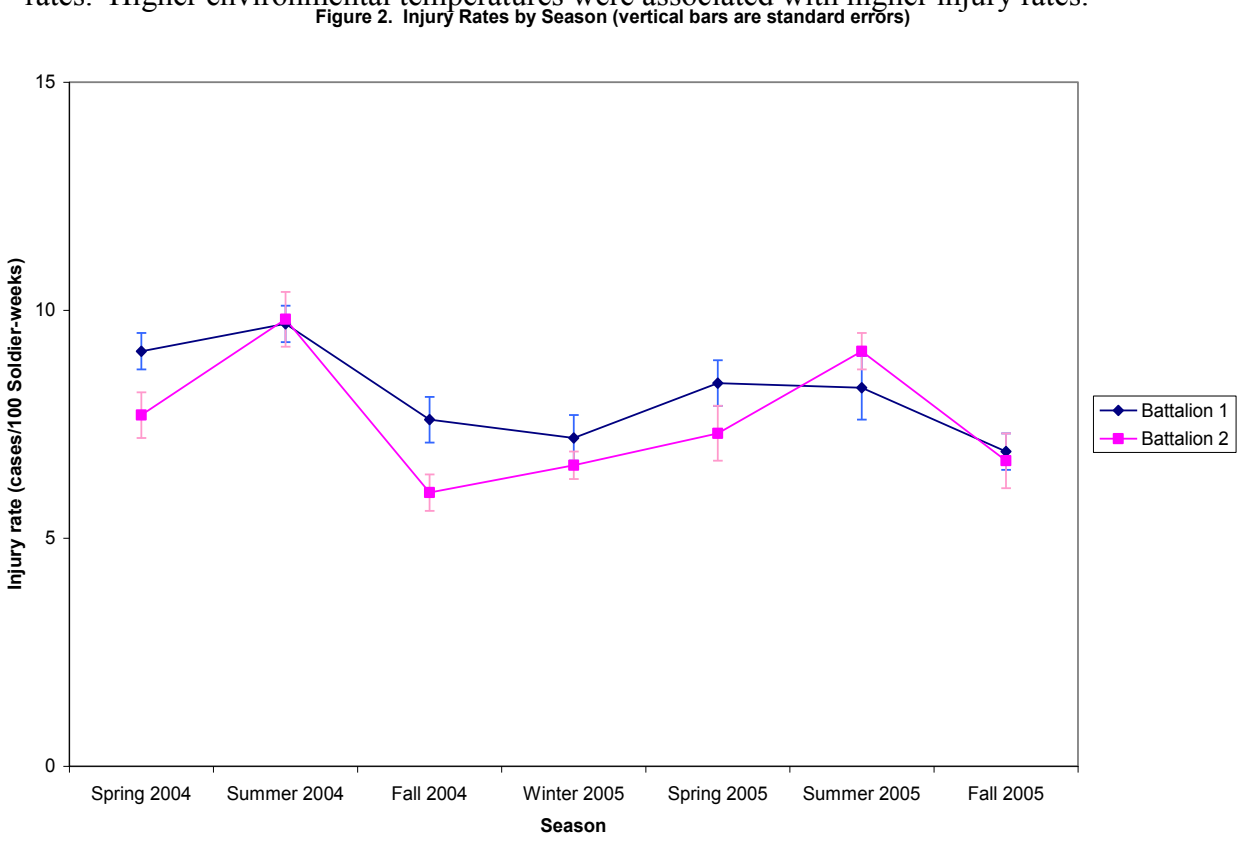


Figure 9. Injury Rates for Two Battalions by Season, 2004–2005

(5) USACHPPM. 2007. Technical Report No. 12-MA01Q2-07, *The Parachute Ankle Brace: Entanglements and Injuries After Controlling for Extrinsic Risk Factors*. (Prepared by: Knapik JJ, Darakjy S, Swedler D, Manning F, Hauret KG, Amoroso P, and Jones BH.)

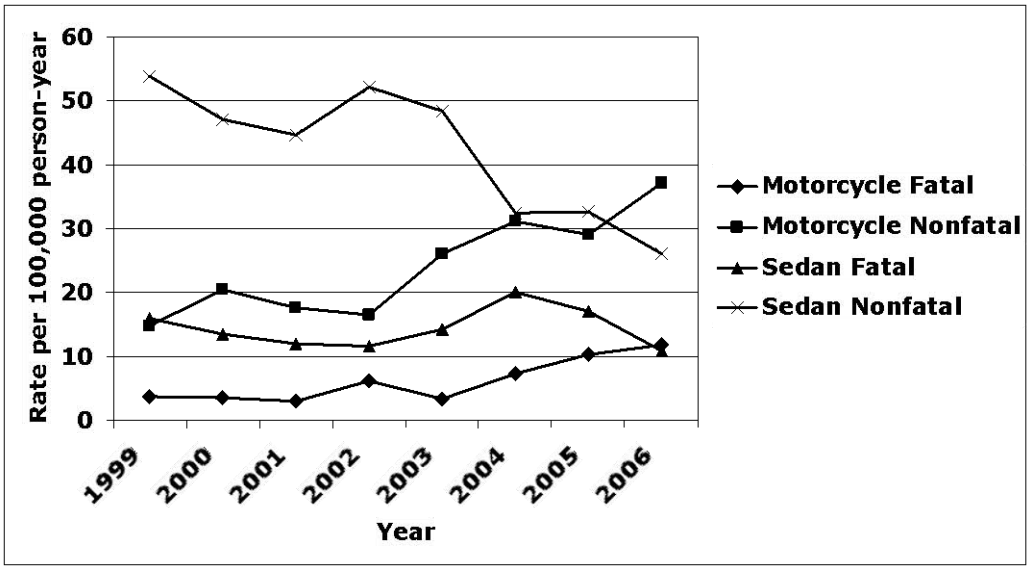
Previous studies have demonstrated that the PAB reduces ankle injuries during military airborne operations. This investigation reevaluated the PAB controlling for extrinsic risk factors. Injury incidence among airborne students wearing the PAB was compared to those not wearing the PAB. Covariate data were collected on extrinsic factors including wind speed, type of jump (administrative-nontactical versus combat load) and time of day (day versus night). A total of 596 injuries occurred in 102,784 jumps. After controlling for covariates in a multivariate model, students who did not wear the brace were 1.90 times more likely (95% confidence index (CI)=1.24-2.90) to experience an ankle sprain, 1.47 times more likely (95%CI=0.82-2.63) to experience an ankle fracture, and 1.75 times more likely (95%CI=1.25-2.48) to experience an ankle injury of any type (Table 7). Injuries to other parts of the lower body (exclusive of the ankle) were not significantly influenced by the brace. The incidences of parachute entanglements were similar among students wearing and not wearing the PAB. Thus, after controlling for covariates known to effect injury rates, the PAB protected against ankle injuries and especially ankle sprains while not influencing parachute entanglements and other lower body injuries exclusive of the ankle.

Table 7. Multivariate Association between Risk Factors and Airborne Injury Incidence (Multivariate Logistic Regression), U.S. Army Airborne Students, 2005–2006

Injury Type	Variable	Level of Variable	Odds Ratio (95%CI)	Wald Statistic p-value
All Injury	Brace Status	Brace	1.00	-----
		No Brace	1.15 (0.93-1.42)	0.18
	Wind Speed	0-1 knot	1.00	-----
		2-5 knots	1.01 (0.77-1.32)	0.97
		6-9 knots	1.53 (1.20-1.97)	<0.01
		10-13 knots	2.13 (1.55-2.92)	<0.01
	Time of Day	Day	1.00	-----
		Night	2.24 (1.70-2.96)	<0.01
	Jump Type	Admin/Nontactical	1.00	-----
		Combat Load	1.26 (1.01-1.57)	0.04
Ankle Sprain	Brace Status	Brace	1.00	-----
		No Brace	1.90 (1.24-2.90)	<0.01
	Time of Day	Day	1.00	-----
		Night	2.62 (1.70-4.03)	<0.01
	Jump Type	Admin/Nontactical	1.00	-----
		Combat Load	1.38 (0.95-2.01)	0.09
Ankle Fracture	Brace Status	Brace	1.00	-----
		No Brace	1.47 (0.82-2.63)	0.19
	Time of Day	Day	1.00	-----
		Night	2.51 (1.37-4.60)	<0.01
	Jump Type	Admin/Nontactical	1.00	-----
		Combat Load	2.34 (1.42-3.85)	<0.01
Any Ankle Injury	Brace Status	Brace	1.00	-----
		No Brace	1.75 (1.25-2.48)	<0.01
	Time of Day	Day	1.00	-----
		Night	2.57 (1.80-3.65)	<0.01
	Jump Type	Admin/Nontactical	1.00	-----
		Combat Load	1.65 (1.22-2.22)	<0.01

(6) USACHPPM. 2007. Army Motorcycle Crashes: A Descriptive Analysis of Accidents from CY 99–06. (Prepared by: Marin RE, Canada S, and Jones BH. Presented at the Annual Force Health Protection Conference.)

Army fatalities due to motor vehicle accidents account for approximately 245 deaths annually. The motor vehicle accident casualties and fatalities can substantially affect missions and deployment readiness. Analysis of unintentional injuries during 1999–2006 was conducted to identify injury types, Soldier demographics, injury causes, and major commands affected. Peer-reviewed journals were queried to quantify the economic burden and delineate motor vehicle accident prevention strategies/policies. The top three motor vehicle types involved in reported fatal accidents in 1999–2006 were, in descending order, sedans, motorcycles, and trucks. Beginning in 2002, there was a rise in motorcycle accidents and fatalities among Soldiers (Figure 10). Fifty-eight percent of Soldiers in reported motorcycle accidents were under 25 years old. The risk of being fatality injured in a motorcycle accident was 2.5 (95% CI=1.96-3.24) times greater if not wearing a helmet. Other risk factors for motorcycle fatality included alcohol use and night time driving. Excessive speed was the top reported mistake made during motorcycle accidents. Systematic surveillance and reporting on MVA, including motorcycle, causes and rates are necessary to identify modifiable factors to mitigate motor vehicle accident fatality rates. Data suggests priority should be placed on promoting helmet use, decreasing alcohol use, and reduction of night time driving.



Source: Army Safety Management Information System, April 2007
Injury Severity missing for 2 vehicles (auto/sedan=1, motorcycle=1)

Figure 10. Rates of Fatalities vs. Non-fatalities for Selected Privately Owned Vehicles (Motorcycle and Sedan), U.S. Army Active Duty, CY 99–06

(7) The USACHPPM IPP produced a number of non-deployment related analyses, field investigations, and program evaluations in 2007. The citations are listed below—

(a) Technical Reports.

- USACHPPM. 2007. Technical Report No. 12MA01Q2-07, *The parachute ankle brace: entanglements and injuries after controlling for extrinsic risk factors*. (Prepared by Knapik JJ, Darakjy S, Swedler D, Manning F, Hauret KG, Amoroso P, and Jones BH.)

(b) Peer-Reviewed Journal Publications and Conference Proceedings.

- Canham-Chervak M, Baker SP, Jones BH. 2007. *Highlighting the need for fall prevention research: The role of evidence-based prioritization of injury programs and policies.* Hopkinton, Massachusetts: Proceedings of the International Ergonomics Association International Conference on Slips, Trips, and Falls.

- Jones, SB. 2007. The validity of self-reported physical fitness test scores. *Mil Med*, 172:115-120.

- Knapik, JJ. 2007. *Friction blisters: pathophysiology, risk factors, and prevention. Journal of Proceedings.* Orlando, Florida: 34th Annual Meeting and Scientific Symposium of the American Academy of Orthotists and Prosthetists.

- Knapik, JJ. 2007. Ambulatory physical activity during United States Army Basic Combat Training. *Int J Sports Med*, 28:106-115.

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- Knapik, JJ. 2007. Mouthguards in sport activities: history, physical properties and injury prevention. *Sports Med*, 37:117-144.

(c) Scientific Abstracts.

- Canada S, Canham-Chervak M, Jones BH, Schmitt C, Strauss W, Buck D, Hauret K. 2007. *Predictors of attrition in U.S. Army basic combat training and in the first two years of enlistment*. American Public Health Association Annual Meeting, Washington, DC.

- Canada S, Canham-Chervak M, Jones BH. 2007. Unpublished abstract. *Trends of injury topics in a major military safety publication*, 1999-2005.

- Canham, Chervak M, S Canada, K Hauret. 2007. *Predictors of injury and attrition in the US Army: Why the interest?* American Public Health Association Annual Meeting, Washington, DC.

- Canham-Chervak M, Shuping EE, Amoroso PJ, Jones BH. 2007. *Falls in a working-age population: the U.S. Army experience*. American Public Health Association Annual Meeting, Washington, DC.

- Canham-Chervak M, Baker SP, Jones BH. 2007. *Highlighting the need for fall prevention research: The role of evidence-based prioritization of injury programs and policies*. International Conference on Slips, Trips, and Falls, Hopkinton, Massachusetts.

- Hauret KG, Canada S, Schmitt C, Strauss W, Buck D, Canham-Chervak M. 2007. *Predictors of injury in U.S. Army basic training and the first two years of military service*. American Public Health Association Annual Meeting, Washington, DC.

- Knapik JJ, Jones SB, Darakjy S, Nevin R, Hauret K, Canham-Chervak M, Jones BH. 2007. *Musical athletes: injuries and injury risk factors in the US Army band*. 54th Annual Meeting of the American College of Sports Medicine, New Orleans, Louisiana. (Published in *Med Sci Sports Exerc* 39: S395, 2007.)

- Marin RE, Canada S, Jones BH. 2007. *Army Motorcycle Crashes: A descriptive analysis of accidents from CY 99–06*. (Annual Force Health Protection Conference, Louisville, Kentucky.)

(d) Scientific Presentations.

- Canada S, Canham-Chervak M, Schmitt C, Strauss W, Buck D, Hauret K. 2007. *Predictors of attrition in U.S. Army basic combat training and in the first two years of enlistment*. American Public Health Association Annual Meeting, Washington, DC.

- Canada S, Canham-Chervak M, Jones B, Strauss W, Nagaraja J, Sloane E, Hauret K. 2007. *The recruit assessment program and predictors of attrition in US Army BCT*. (Annual Force Health Protection Conference, Louisville, Kentucky.)

- Canham-Chervak M, Shuping EE, Amoroso PJ, and Jones BH. 2007. *Falls in a working-age population: the U.S. Army experience*. American Public Health Association Annual Meeting, Washington, DC.

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- Hauret KG, Canada S, Jones BH. 2007. *The Recruit Assessment Program and predictors of injury in Army Basic Combat Training*. (Annual Force Health Protection Conference, Louisville, Kentucky.)

- Jones BH. 2007. Risks of Musculoskeletal Injury, *Workshop on the Adequacies of Evidence for Physical Activity Guidelines Development*. National Academy of Science Institute of Medicine, Washington, DC.

- Jones BH. 2007. *Army injury epidemiology and prevention: A public health approach*. Metropolitan Washington DC Chapter of the American College of Occupational and Environmental Medicine, Washington, DC.

- Knapik JJ. 2007. *Seasonal variations in injury rates in United States Army Ordnance Training*. (Annual Forces Health Protection Conference, Louisville Kentucky.)

- Knapik JJ, Jones SB, Darakjy S, Nevin R, Hauret KG, Canham-Chervak M, Jones BH. 2007. *Musical athletes: Injuries and injury risk factors in the US Army Band*. 54th Annual Meeting of the American College of Sports Medicine.

- Marin RE, Canada S, Jones BH. 2007. Army motorcycle crashes: A descriptive analysis of accidents from CY 99–06. (Annual Force Health Protection Conference, Louisville, Kentucky.)

7. CONCLUSIONS.

a. Army Injury Surveillance Summary 2007: Deaths, Hospitalizations, and Outpatient Visits. This section summarizes available medical surveillance data on injuries affecting active duty, non-deployed U.S. Army Soldiers. Key findings indicated—

(1) For every 1 injury-related death, there were 20 hospitalizations and 1,512 outpatient visits in 2007.

(2) Injury was the leading cause of medical encounters (899,381 medical encounters in 2007), affecting over 390,000 Soldiers.

(3) Among Army Soldiers, injury visit rates, particularly overuse injury rates, have been increasing in recent years (22.8 percent–from 2005-2007, while rates among Army trainees from 2003 to 2007 declined by 27.2 percent).

(4) Injury was one of the leading causes of hospitalization among Army Soldiers (6,846 hospitalizations in 2007), exceeded only by mental disorder. However, injury and injury-related musculoskeletal conditions resulted in more outpatient visits (514,083 outpatient visits) than any other medical condition.

(5) The most frequently reported causes of unintentional injuries that required hospitalization were falls or near-falls (16.9 percent), land transport accidents (16.8 percent), and athletics/sports (11.9 percent).

(6) The most common types of injury leading to hospital admission were fractures (35.9 percent), internal injuries (12.2 percent) and sprains/strains (10.2 percent). Injury

hospitalizations were more likely to involve the lower extremities or the head, face, and neck regions.

(7) Injury-related outpatient visits were most commonly the result of sprains and/or strains (48.9 percent), contusions/superficial wounds (17.0 percent), and fractures (9.3 percent), particularly sprains and strains to the lower leg, ankle, shoulder, and upper arm.

(8) The most common types of injury-related musculoskeletal conditions leading to hospital admission were joint derangement (49.5 percent), inflammation and pain associated with overuse (23.3 percent), and sprains/strains/ruptures (15.4 percent). Injury-related musculoskeletal conditions resulting in hospitalizations were more likely to involve the spine/back or extremities.

(9) Most injury-related outpatient visits were due to inflammation and pain associated with overuse (85.6 percent), followed by joint derangement (7.4 percent) and joint derangement with neurological involvement (2.9 percent), primarily affecting the spine/back and the extremities.

b. Army Injury Epidemiology Project Summaries 2007: Analyses, Investigations, and Evaluations. Conclusions from USACHPPM IPP non-deployment related injury investigations completed in 2007 were as follows:

(1) USACHPPM. 2007. *The Recruit Assessment Program and Predictors of Injury in U.S. Army Basic Combat Training.* (Prepared by: Hauret, KG, Canada S, Canham-Chervak, M. and Jones BH.) Overall, 26 percent of male and 52 percent of female recruits in the study population were injured during BCT at Fort Jackson in FY03. Univariate analysis indicated that the number of cigarette packs smoked daily was associated with BCT injury for both male and female recruits. In multivariate modeling, the number of cigarette packs smoked daily was an independent risk factor for injury among females only. Age at onset of smoking was a stronger independent risk factor for BCT injury among male recruits than the number of packs smoked. Less frequent participation in sport/activity was associated with a higher probability of BCT injury among female recruits. Additional independent BCT injury risk factors were identified in the multivariate analysis, including: older age, higher BMI, and lower education for both male and female recruits; white race; history of being assaulted or impacted by emotional health; early onset of smoking; stiff/painful joints for male recruits; multiple family relocations as a child; fewer close friends/relatives; treated for on-the-job injury; missed work due to injury; less physically active; and higher number of cigarette packs smoked daily for female recruits.

(2) USACHPPM. 2007. *The Recruitment Assessment Program and Predictors of Attrition in U.S. Army Basic Combat Training.* (Prepared by: Canada S, Canham-Chervak, M, Schmitt C, Strauss W, Buck D, and Hauret K.) Overall, attrition for study population (9

percent) was similar to attrition for all recruits at Fort Jackson (10 percent) in FY03. Thirteen percent of female recruits in the study population attrited during BCT compared to 6 percent of male recruits. Consistent with prior studies, the following risk factors were significant predictors of BCT attrition in the multivariate analysis: regular cigarette smoking and lower AFQT for both male and female recruits; previous injury for male recruits; and history of sexual abuse for female recruits. This analysis also indicated that self-reported "poor" general health, work and daily activity limitations due to physical health, history of shortness of breath, and citing travel and adventure as reasons for joining the military were associated with higher attrition for both male and female recruits. Days in Physical Training and Rehabilitation Program and number of allergies were also identified as significant predictors of female attrition during BCT. In addition, male recruits with a history of knee trouble were associated with higher BCT attrition.

(3) USACHPPM. 2007. *Trends of Injury Topics in a Major Military Safety Publication, 1999- 2005*. (Prepared by: Canada S, Canham-Chervak M, and Jones BH.) Two of the top five causes of injury hospitalizations, private vehicle accidents, and machinery/tools are among the top five injury topics covered in the U.S. Army safety publications, *Countermeasure*, from 1999 to 2005. However, two of the other top five causes of injury hospitalizations—falls and athletics/sports—ranked 9th and 13th of the *Countermeasure* articles appearing from 1999 to 2005. Since *Countermeasure* only addresses ground accidents, air transport was not addressed in the publication and a comparison could not be made.

(4) USACHPPM. 2007. *Seasonal Variations in Injury Rates in United States Army Ordnance Training*. (Prepared by: Knapik JJ, Jones S, and Jones BH.) The findings support previous work conducted in BCT, which demonstrated seasonal variations in injury rates—the highest during summer months—potentially due to higher environmental temperatures.

(5) USACHPPM. 2007. *The Parachute Ankle Brace: Entanglements and Injuries After Controlling for Extrinsic Risk Factors*. (Prepared by: Knapik JJ, Darakjy S, Swedler D, Manning F, Hauret KG, Amoroso P, and Jones BH.) Consistent with previous studies, the PAB reduced ankle injuries during military airborne operations. This investigation expanded on previous work by showing that this protective effect was retained even when other known extrinsic parachute injury factors were taken into account. After controlling for covariates known to affect injury rates, the PAB protected against ankle injuries and especially ankle sprains while not increasing parachute entanglements or causing other lower body injuries exclusive of the ankle.

(6) USACHPPM. 2007. *Army Motorcycle Crashes: A Descriptive Analysis of Accidents from CY 99–06.* (Prepared by: Marin RE, Canada S, and Jones BH.) Beginning in 2002, motorcycle accidents and fatalities among Army Soldiers have been on the rise. Alcohol use, no helmet use, and night time driving are risk factors for being fatally injured in a motorcycle crash.

8. RECOMMENDATIONS.

a. Army Injury Surveillance Recommendations 2007.

(1) Given the magnitude of the injury problem in the Army as demonstrated by these data, resources should be directed toward injury prevention and research activities.

(2) To systematically address Army injuries, a data-driven process is recommended to prioritize and focus prevention and research efforts on leading injury problems.[40]

(a) The process should include the analysis of non-fatal medical surveillance data, as presented in this report, given that the bulk of the Army injury burden is nonfatal injuries.

(b) When formulating prevention priorities, factors that should be considered include the frequency, incidence, and severity of injuries, resulting costs, size of the population at risk, preventability of the problem, feasibility of establishing prevention programs or policies, and the ability to evaluate the effect of implemented programs and policies.

(c) When formulating research priorities, factors that should be considered include the frequency, incidence, and severity of injuries, resulting costs, size of the population at risk, existence of gaps in knowledge, military uniqueness, potential value of the research, and feasibility of the research.

(3) Results of this analysis should be used to inform injury prevention and research priorities.

(a) Falls/near falls, transport accidents, and sport-related injuries were identified as the leading the causes of serious (hospitalized) injuries in 2007.

(b) Fractures, sprains, and strains, and overuse injuries of the back and lower extremities were identified as the leading injury types in 2007.

(d) Data in this report should also be combined with future injury surveillance analyses to identify trends in injury rates and causes over time.

b. Army Injury Epidemiology Project Recommendations 2007: Analyses, Investigations, and Evaluations.

(1) USACHPPM, *Predictors of Injury in U.S. Army Basic Training and in the First 2 Years of Military Service.* Analyses exploring the associations of self-reported health status and health risk behaviors should be conducted for additional time periods (first 6 months of service and pre- and post-deployment periods) using the Recruit Assessment Program data set. Results should be used to inform injury prevention program development.

(2) USACHPPM, *Predictors of Attrition in U.S. Army Basic Combat Training and in the First 2 Years of Military Service.* Similar attrition risk factor analyses for post-basic combat training, including first 6 months of service, time after first deployment, and first- term enlistment should be explored using the Recruit Assessment Program data set. Develop targeted screening and prevention programs aimed at reducing attrition, considering significant risk factors identified in this analysis.

(3) USACHPPM, *Trends of Injury Topics in a Major Military Safety Publication, 1999-2005.* To enhance contributions toward injury prevention, publications that serve as a key means of disseminating safety information should attempt to focus their content on leading causes of injury as defined by medical surveillance data.

(4) USACHPPM, *Seasonal Variations in Injury Rates in United States Army Ordnance Training.* Leaders should be aware that injuries will be higher in the summer and should follow the work/rest recommendations and water replacement guidelines in Field Manual 21-10*, Field Hygiene and Sanitation,* 21 June 2000.

(5) USACHPPM, *The Parachute Ankle Brace: Entanglements and Injuries after Controlling for Extrinsic Risk Factors.* The PAB should be used during military parachute training to reduce injuries. Further studies in operational units should be conducted with experienced parachutists to see if the PAB can increase operational combat capability through injury reduction.

(6) USACHPPM, *Army Motorcycle Crashes: A Descriptive Analysis of Accidents from CY 99-06.* Systematic surveillance and reporting on motor vehicle accident causes and rates are necessary to identify modifiable factors to mitigate motor accident fatality rates. Data suggest priority should be placed on promoting helmet use, decreasing alcohol use, and reduction of nighttime driving.

9. POINT OF CONTACT. The point of contact at USACHPPM is Ms. Esther Laseinde, Injury Prevention Program, commercial (410) 436-9290/3534, or DSN 584-9290/3534. Ms. Laseinde may also be reached by electronic mail at esther.laseinde@us.army.mil. For additional injury-related information and resources, visit the USACHPPM Injury Prevention Program website at http://chppm-www.apgea.army.mil/DEDS-Injury.

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Reviewed by:
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Injury Prevention Program

APPENDIX A
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APPENDIX B
INJURY DIAGNOSIS CODES (ICD9-CM CODES†)
CATEGORIZATION BY ANATOMICAL REGION

Head and neck

363.61 363.63 364.04 364.41 364.76 364.77 365.65 366.20 379.32 379.33 379.34 525.11 722.0 722.71 723.1 723.4 800 801 802 803
804 805.0 805.1 806.0 806.1 807.5 807.6 830 839.0 839.1 847.0 848.0 848.1 848.2 850 851 852 853 854 870 871 872 873 874 900 910.0 910.1 910.2 910.3 910.6 910.7 910.8 910.9 918 920 921 925 930 931 932 933 935.0 940 941 947.0 950 951 952.0 953.0 954.0 957.0 959.0

Shoulder and arm

354.1 354.2 354.3 716.11 716.12 716.13 718.01 718.02 718.03 718.11 718.12 718.13 718.31 718.32 718.33 718.81 718.82 718.83 718.91 718.92 718.93 719.01 719.02 719.03 719.11 719.12 719.13 719.41 719.42 719.43 726.0 726.1 726.2 726.3 727.61 727.62 733.11 810 811 812 813 818 831 832 840 841 880 881.00 881.01 881.10 881.11 881.20 881.21 887 903.0 903.1 912.0 912.1 912.2 912.3 912.6 912.7 912.8 912.9 923.0 923.1 927.0 927.1 943 953.4 955.0 955.1 955.2 955.3 955.4 955.5 955.7 955.8 955.9 959.2

Hand and wrist

354.0 716.14 718.04 718.14 718.34 718.84 718.94 719.04 719.14 719.44 726.4 727.63 727.64 733.12 814 815 816 817 833 834
842 881.02 881.12 881.22 882 883 885 886 903.4 903.5 914.0 914.1 914.2 914.3 914.6 914.7 914.8 914.9 915.0 915.1
915.2 915.3 915.6 915.7 915.8 915.9 923.2 923.3 927.2 927.3 944 955.6 959.4 959.5

Leg

716.15 716.16 718.05 718.15 718.35 718.85 718.95 **719.05** 719.15 **719.45 726.5 727.65 733.14 733.15 733.93** 808.0 808.1 820 821 823 835 **843 844.3** 890 897 904.0 904.1 904.2 904.3 904.5 924.0 924.10 928.0 928.10 945.00 945.04 945.06 945.09 945.10 945.14
945.16 945.19 945.20 945.24 945.26 945.29 945.30 945.34 945.36 945.39 945.40 945.44 945.46 945.49 945.50 945.54 945.56 945.59 956 959.6

Knee

717 718.36 718.86 **719.06** 719.16 **719.46 726.6 727.66** 822 836 **844.0 844.1 844.2** 924.11 928.11 945.05 945.15 945.25 945.35 945.45
945.55

Ankle and foot

716.17 718.07 718.17 718.37 718.87 718.97 **719.07** 719.17 **719.47 726.7 727.67 727.68 728.71 733.94 734** 824 825 826 837 838

845 892 893 895 896 904.6 917.0 917.1 917.2 917.3 917.6 917.7 917.8 917.9 924.2 924.3 928.2 928.3 945.01 945.02 945.03 945.11 945.12 945.13 945.21 945.22 945.23 945.31 945.32 945.33 945.41 945.42 945.43 945.51 945.52 945.53

Chest, back, and abdomen

720.2 721.7 722.1 722.72 722.73 **724.2** 724.3 724.4 **724.5 724.9** 733.13 805.2 805.3 805.4 805.5 805.6 805.7 806.2 806.3 806.4
806.5 806.6 806.7 807.0 807.1 807.2 807.3 807.4 808.2 808.3 808.4 808.5 808.8 808.9 809 839.2 839.3 839.41 839.42 839.51
839.52 839.61 839.71 **846** 847.1 **847.2 847.3 847.4 847.9** 848.3 848.4 **848.5** 860 861 862 863 864 865 866 867 868 869 875 876 877 878 879.0 879.1 879.2 879.3 879.4 879.5 879.6 879.7 901 902 911.0 911.1 911.2 911.3 911.6 911.7 911.8 911.9 922 926 934 935.1 935.2 936 937 938 939 942 947.1 947.2 947.3 947.4 952.1 952.2 952.3 952.4 953.1 953.2 953.3 953.5 954.1 954.8 954.9 959.1 959.11 959.12 959.19

Environmental

363.31 370.24 388.10 388.11 388.12 692.71 692.76 692.77 910.4 910.5 911.4 911.5 912.4 912.5 913.4 913.5 914.4 914.5 915.4 915.5
916.4 916.5 917.4 917.5 919.4 919.5 990 991 992 993 994

Unspecified

716.10 716.18 716.19 718.00 718.08 718.09 718.10 718.18 718.19 718.30 718.38 718.39 718.80 718.88 718.89 718.90 718.98 718.99 **719.00 719.08 719.09** 719.10 719.18 719.19 **719.40 719.48 719.49** 722.2 722.70 **726.8 726.9 727.2 727.3** 727.60 727.69 728.83 **729.1** 729.2 **733.10 733.16 733.19 733.95** 805.8 805.9 806.8 806.9 819 827 828 829 839.40 839.49 839.50 839.59 839.69 839.79 839.8 839.9 **844.8 844.9 848.8 848.9** 879.8 879.9 884 891 894 903.2 903.3 903.8 903.9 904.4 904.7 904.8 904.9 913.0 913.1 913.2 913.3 913.6 913.7 913.8 913.9 916.0 916.1 916.2 916.3 916.6 916.7 916.8 916.9 919.0 919.1 919.2 919.3 919.6 919.7 919.8 919.9 923.8

923.9 924.4 924.5 924.8 924.9 927.8 927.9 928.8 928.9 929 946 947.8 947.9 948 949 952.8 952.9 953.8 953.9 957.1 957.8 957.9 959.13 959.14 959.3 959.7 959.8 959.9 995.81 995.83 995.85

Note: Bolded codes represent lower extremity overuse injuries.

†*The International Classification of Diseases, Ninth Revision, Clinical Modification, (ICD-9-CM) is a standardized classification system used for coding and classifying diseases, injuries, and conditions diagnosed in the United States*.

APPENDIX C
BARELL INJURY DIAGNOSIS MATRIX AND ASSOCIATED ICD-9-CM 800–999 CODES[13]

				ICD-9-CM Codes	FRACTURE 800-829	DISLOCATION 830-839	SPRAINS/ STRAINS 840-848	INTERNAL 850-854,860-869 952,995.55	OPEN WOUND 870-884, 890-894	AMPUTATIONS 885-887, 895-897	BLOOD VESSELS 900-904	CONTUSION/ SUPERFICIAL 910-924	CRUSH 925-929	BURNS 940-949	NERVES 950-951 953-957	UNSPECIFIED 959
Head and Neck	Traumatic Brain Injury	1	Type 1 TBI	800,801,803,804(.1-.4,.6-.9),(.03-.05,.53-.55) 850(.2-.4),851-854,950(.1-.3),995.55	800,801,803,804(.1-.4,.6-.9) 800,801,803,804(.03-.05,.53-.55)	/	/	850(.2-.4) 851-854*, 995.55	/	/	/	/	/	/	950.1-.3	/
		2	Type 2 TBI	800,801,803,804(.00,.02,.06,.09),(.50,.52,.56,.59),850(.0,.1,.5,.9)	800,801,803,804(.00,.02,.06, .09), 800,801,803,804(.50,.52,.56, .59)			850(.0,.1,.5,.9)								
		3	Type 3 TBI	800,801,803,804(.01,.51)	800,801,803,804(.01,.51)	/	/	/	/	/	/	/	/	/	/	/
	Other head, face, neck	4	Other Head	873(.0-.1,.8-.9), 941.x6, 951, 959.01	/	/	/	/	873.0-.1,.8-.9	/	/	/	/	941.x6	951	959.01*
		5	Face	802, 830, 848.0-.1, 872, 873.2-.7, 941(.x1,.x3-.x5,.x7)	802	830	848.0-.1	/	872, 873.2-.7	/	/	/	/	941.x1,.x3-.x5,.x7	/	/
		6	Eye	870-871, 918, 921, 940, 941.x2, 950(.0,.9)	/	/	/	/	870-871	/	/	918, 921	/	940, 941.x2	950(.0,.9)	/
		7	Neck	807.5-.6, 848.2, 874, 925.2, 941.x8, 953.0, 954.0	807.5-.6	/	848.2	/	874	/	/	/	925.2	941.x8	953.0, 954.0	/
		8	Head, Face, and Neck Unspecified	900, 910, 920, 925.1, 941.x0, .x9, 947.0, 957.0, 959.09	/	/	/	/	/	/	900	910, 920	925.1	941.x0,.x9, 947.0	957.0	959.09
Spine and Back	Spinal Cord (SCI)	9	Cervical SCI	806(.0-.1), 952.0	806.0-.1	/	/	952.0	/	/	/	/	/	/	/	/
		10	Thoracic/Dorsal SCI	806(.2-.3), 952.1	806.2-.3	/	/	952.1	/	/	/	/	/	/	/	/
		11	Lumbar SCI	806(.4-.5), 952.2	806.4-.5	/	/	952.2	/	/	/	/	/	/	/	/
		12	Sacrum Coccyx SCI	806(.6-.7), 952(.3-.4)	806.6-.7	/	/	952.3-.4	/	/	/	/	/	/	/	/
		13	Spine + Back unspecified SCI	806(.8-.9), 952(.8-.9)	806.8-.9	/	/	952.8-.9	/	/	/	/	/	/	/	/
	Vertical Column (VCI)	14	Cervical VCI	805(.0-.1), 839(.0-.1), 847.0	805.0-.1	839.0-.1	847.0	/	/	/	/	/	/	/	/	/
		15	Thoracic/Dorsal VCI	805(.2-.3), 839(.21,.31), 847.1	805.2-.3	839.21,.31	847.1	/	/	/	/	/	/	/	/	/
		16	Lumbar VCI	805(.4-.5), 839(.20,.30), 847.2	805.4-.5	839.20,.30	847.2	/	/	/	/	/	/	/	/	/
		17	Sacrum Coccyx VCI	805(.6-.7), 839(.41-.42), 839(.51-.52), 847.3-.4	805.6-.7	839(.41-.42, .51-.52)	847.3-.4	/	/	/	/	/	/	/	/	/
		18	Spine + Back unspecified VCI	805(.8-.9), 839(.40,.49), 839(.50,.59)	805.8-.9	839(.40,.49,.50,.59)	/	/	/	/	/	/	/	/	/	/
Torso	Torso	19	Chest (thorax)	807(.0-.4), 839(.61,.71), 848(.3-.4), 860-862, 875, 879(.0-.1), 901, 922(.0-.1,.33), 926.19, 942.x1-.x2 953.1	807.0-.4	839.61,.71	848.3-.4	860-862	875, 879.0-.1	/	901	922(.0-.1,.33)	926.19	942.x1-x2	953.1	/
		20	Abdomen	863-866, 868, 879(.2-.5), 902(.0-.4), 922.2,942.x3, 947.3, 953(.2,.5)	/	/	/	863-866, 868	879.2-.5	/	902.0-.4	922.2	/	942.x3, 947.3	953.2, 953.5	/
		21	Pelvis & Urogenital	808, 839(.69,.79), 846, 848.5, 867,877-878 902(.5,.81-.82), 922.4, 926(.0,.12), 942.x5,947.4, 953.3	808	839.69,.79	846, 848.5	867	877-878	/	902(.5, .81-.82)	922.4	926(.0, .12)	942.x5, 947.4	953.3	/
		22	Trunk	809, 879(.6-.7), 911, 922(.8-.9), 926(.8-.9), 942(.x0,.x9), 954(.1,.8-.9), 959.1	809	/	/	/	879.6-.7	/	/	911, 922.8-.9	926.8-.9	942.x0, 942.x9	954.1, .8-.9	959.1
		23	Back and Buttock	847.9, 876, 922(.31-.32), 926.11, 942.x4	/	/	847.9	/	876	/	/	922.31-.32	926.11	942.x4	/	/
Extremities	Upper	24	Shoulder & Upper Arm	810-812, 831, 840, 880, 887(.2-.3), 912,923.0, 927.0, 943(.x3-.x6) ,959.2	810-812	831	840	/	880	887.2-.3	/	912, 923.0	927.0	943.x3-.x6	/	959.2
		25	Forearm, Elbow	813, 832, 841, 881(.x0-.x1), 887(.0-.1), 923.1, 927.1, 943(.x1-.x2)	813	832	841	/	881.x0-.x1	887.0-.1	/	923.1	927.1	943.x1-x2	/	/
		26	Wrist, Hand, & Fingers	814-817, 833-834, 842,881.x2, 882, 883, 885-886, 914-915, 923(.2-.3) ,927(.2-.3), 944 ,959(.4-.5)	814-817	833, 834	842 /	/ /	881.x2,882, 883	885-886	/ /	914-915, 923.2-.3	927.2-.3	944 /	/ /	959.4-.5
		27	Other & unspecified	818, 884, 887(.4-.7), 903, 913, 923(.8-.9), 927(.8-.9), 943(.x0,.x9), 953.4, 955, 959.3	818	/	/	/	884	887.4-.7	903	913,923.8,.9	927.8-.9	943.x0,.x9	953.4, 955	959.3
	Lower	28	Hip	820, 835, 843, 924.01, 928.01	820	835	843	/	/	/	/	924.01	928.01	/	/	/
		29	Upper leg & thigh	821, 897(.2-.3), 924.00, 928.00, 945.x6	821			/	/	897.2-.3	/	924.00	928.00	945.x6	/	/
		30	Knee	822, 836, 844.0-.3, 924.11, 928.11, 945.x5	822	836	844.0-.3	/	/	/	/	924.11	928.11	945.x5	/	/
		31	Lower leg & ankle	823-824, 837, 845.0, 897(.0-.1), 924(.10-.21), 928(.10-.21), 945(.x3-.x4)	823-824	837	845.0	/		897.0-.1	/	924.10,.21	928.10,.21	945.x3-.x4	/	/
		32	Foot & toes	825-826, 838, 845.1, 892-893, 895-896, 917, 924(.3-.20), 928 (.3-.20), 945 (.x1-.x2)	825-826	838	845.1	/	892-893	895-896	/	917, 924.3-.20	928.3-.20	945.x1-.x2	/	/
		33	Other & unspecified	827,844(.8-.9), 890-891, 894, 897(.4-.7), 904(.0-.8), 916, 924(.4-.5), 928(.8-.9), 945(.x0,.x9), 959.6-.7	827	/	844.8,.9	/	890-891,894	897.4-.7	904.0-.8	916, 924.4-.5	928.8,.9	945.x0,.x9	/	959.6-.7
Unclassified by Site	Other & unspecified	34	Other/multiple	819, 828, 902(.87,.89), 947(.1-.2), 953.8, 956	819, 828	/	/	/	/	/	902.87,.89	/	/	947.1-.2	953.8, 956	/
		35	Unspecified site	829, 839(.8-.9), 848(.8-.9), 869, 879(.8,.9), 902.9, 904.9, 919,924(.8,.9), 929, 946, 947(.8,.9), 948, 949, 953.9, 957(.1,.8,.9), 959(.8,.9)	829	839.8-.9	848.8-.9	869	879(.8-.9)	/	902.9, 904.9	919, 924.8,.9	929	946, 947.8,.9 948, 949	953.9, 957.1,.8,.9	959.8,.9
	System wide	36	System-wide & late effects	905-908, 909 (.0,.1,.2,.4,.9), 930-939,958, 960-994, 995.50-.54,.59, 995(.80-.85)	Foreign body (930-939), Early complications of trauma (958), Poisoning (960-979), Toxic Effects (980-989), Other and unspecified effects of external cause (990-994) Child and adult maltreatment (995.50-.54,.59, 995.80-.85) Late effects of injuries, poisonings, toxic effects and other external causes(905-909) excluding 909(.3, .5)											

APPENDIX D
INJURY-RELATED MUSCULOSKELETAL MATRIX AND ASSOCIATED ICD-9-CM 710–739 CODES

			Pain and Inflammation	Pain/Inflammation with Nerves	Stress Fracture	Sprains/Strains/Rupture	Dislocation	Other Joint Derangement
Spine and Back	Vertebral Column (VCI)	Cervical VCI	723.1	722.71, 723.4				722.0
		Thoracic/Dorsal VCI		722.72, 724.4				722.11
		Lumbar VCI	724.2	722.73, 724.3				722.10
		Sacrum Coccyx VCI	720.2					
		Spine, Back Unspec. VCI	721.7, 724.5	722.70, 724.9	733.13			722.2
Extremities	Upper	Shoulder	716.11, 719(.01,.11,.41), 726(.0,.1,.10-.12,.19,.2)			727(.61-.62)	718.31	718(.01,.11,.81,.91)
		Upper arm, Elbow	716.12, 719(.02,.12,.42), 726(.3-.33,.39)		733.11		718.32	718(.02,.12,.82,.92)
		Forearm, Wrist	716.13, 719(.03,.13,.43), 726.4		733.12		718.33	718(.03,.13,.83,.93)
		Hand	716.14, 719(.04,.14,.44)			727(.63-.64)	718.34	718(.04,.14,.84,.94)
	Lower	Pelvis, Hip, Thigh	716.15, 719(.05,.15,.45), 726.5		733(.14-.15)	727.65	718.35	718(.05,.15,.85,.95)
		Lower leg, Knee	716.16, 717.7, 719(.06,.16,.46), 726(.6-.65,.69)		733(.16,.93-.94)	717(.8,.81-.85,.89), 727(.66-.67)	718.36	717,717(.0-.6,.40-.43,.49,.9), 718(.06,.16,.86,.96)
		Ankle, Foot	716.17, 719(.07,.17,.47), 726(.7-.73,.79), 728.71, 734			727.68	718.37	718(.07,.17,.87,.97)
Unclass. by Site	Others and Unspecified	Other specified/Multiple	719(.08-.09,.18-.19,.48-.49), 726.8, 727.2		733.19	727.69	718(.38,.39)	718(.08,.09,.18,.19,.88,.89,.98,.99)
		Unspec. Site	716.10, 719(.00,.10,.40), 726(.9,.90-.91), 727.3, 729.1	729.2	733(.10,.95)	727.60, 728.83	718.30	718(.00,.10,.80,.90)